

Factors Affecting Chronic Energy Deficiency among Pregnant Women in East Nusa Tenggara Province, Indonesia

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ABSTRACT

This study aims to investigate the relationship between maternal and household characteristics with the Chronic Energy Deficiency (CED) occurrence among pregnant women in East Nusa Tenggara (ENT). CED was observed through Mid-Upper Arm Circumference (MUAC) measurement of < 23.5 cm. Utilizing a cross-sectional design using secondary data from the 2018 Indonesia Basic Health Survey (Riskesmas) involving 387 pregnant women. Bivariate analysis (chi-square test) and multivariate analysis (multiple logistic regression) were conducted. Significant associations with the CED included parity ($p=0.002$), education level ($p=0.018$), access to hospital (transportation mode) ($p=0.032$), and access to primary healthcare facilities (travel time) ($p=0.032$). Multivariate analysis identified parity as the most influential variable for the CED occurrence among pregnant women ($p=0.016$; OR=1.868). In conclusion, mothers with a parity of less than two or more than three children had a higher risk of experiencing CED during pregnancy in ENT. To prevent CED and its consequences, it is recommended to emphasize family planning, address parity concerns, and prioritize maternal nutritional status before and during pregnancy.

Keywords: CED, maternal, pregnant, parity

INTRODUCTION

Chronic Energy Deficiency (CED) in pregnant women occurs when a mother experiences prolonged or long-term energy deprivation. CED in pregnant women can be identified with Mid-Upper Arm Circumference (MUAC) measurement (<23.5 cm). According to the Ministry of Health Republic of Indonesia 2002, CED can lead to various health problems for pregnant women (MoH RI 2002). In addition, CED also indirectly contributes to maternal and infant mortality rates (Apriyanti 2017). The 2018 Indonesia Basic Health Survey (Riskesmas) stated that the CED prevalence in Indonesia is still relatively high (17.3%). East Nusa Tenggara is one of the provinces in Indonesia with the highest CED prevalence in pregnant women (36.8%) (MoH RI 2018). According to various studies, CED in pregnant women leads to suboptimal fetal growth, low birth weight, premature birth, increased risk of miscarriage, malnutrition, and infant mortality at birth. Pregnant women with CED potentially have a 4.85 times higher risk of giving birth to stunted children (Ruaida

& Soumokil 2018). The CED occurrence in pregnant women can also have long-term impacts on children. If the child experiences malnutrition, such as stunting, they will have a higher risk of degenerative diseases later in adulthood (Sandjaja 2014; Tejayanti 2020).

Various factors can influence the CED occurrence in pregnant women, such as age, parity, infectious disease, Antenatal Care (ANC), education level, residential area, environmental hygiene, and access to healthcare facilities. Those factors can be classified into two groups based on the characteristics of the pregnant women and the household characteristics. The factors that are considered as the characteristics of the pregnant women are age, parity, infectious disease, ANC, and education level, while the other factors such as residential area, environmental hygiene, and access to healthcare facilities are considered as the household characteristics. Considering its high prevalence in East Nusa Tenggara (ENT) and potential harm it may impose, this study aims to investigate the relationship between maternal and household characteristics with the occurrence of CED in pregnant women in East

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Nusa Tenggara Province based on the 2018 Riskesdas data. In hope, this study will provide insights for designing appropriate intervention programs to prevent future maternal and child nutrition problems within in the region.

METHODS

Design, location, and time

This is a quantitative study with a cross-sectional design. This study analyzed the 2018 Riskesdas data collected by the Health Development Policy Agency of the Ministry of Health, Republic of Indonesia, in East Nusa Tenggara (ENT) Province. Ethical approval was obtained from the Ethics Commission for Health Research at UPN Veteran Jakarta with the number 81/V/2023/KEPK.

Sampling

The population in this study was pregnant mothers in ENT from the 2018 Riskesdas. The inclusion criteria in this research are pregnant women who have MUAC data through measurements and the exclusion criteria is pregnant women with extreme MUAC value.

The data initially obtained was 395 respondents who were then selected according to the sample inclusion criteria. No extreme MUAC value was found. After further cleaning of missing data on MUAC (n=8), therefore, the final research sample size was 387 respondents.

Data collection

The sampling technique used in Riskesdas 2018 was the Probability Proportional to Size (PPS) method, which involves implicit stratification of all census blocks based on socioeconomic strata to ensure the representation of household characteristic diversity.

The instruments used in this research were Household Instruments and Individual Instruments from Riskesdas 2018. MUAC measurements were carried out using MUAC tape with an accuracy of 1 mm.

The CED prevalence in pregnant women was observed through MUAC measurement. The MUAC measurement of <23.5 cm indicates that the pregnant woman is considered at risk of CED (MoH RI 2017). MUAC is the preferred tool to measure CED due to its independency of the pregnancy status. The composition of the upper

arm mainly consists of fat and muscle, so it is not affected by body fluid and can be measured at any time during pregnancy (Sufyan *et al.* 2020).

Data analysis

This study used two stages of analysis; bivariate and multivariate analysis. The bivariate analysis was performed using the Chi-square test with a significance level of 5%. Furthermore, the multivariate analysis was performed using the Multiple Logistic Regression test. All statistical analysis was performed using the IBM SPSS Statistics 24 software.

RESULTS AND DISCUSSION

The independent variables in this study have different frequencies (n) for each variable. Based on the power of test analysis to assess the accuracy, a result of 98% was obtained. This indicates that the study can detect the true relationship between the variables under investigation.

Based on Table 1, it is shown that 36.8% of pregnant women in ENT Province were at risk of CED. It means that 36.8% of pregnant women in ENT Province were experiencing CED during their pregnancy. CED among pregnant women is a significant public health concern, and that high prevalence in East Nusa Tenggara Province in Indonesia is considered as a concerning statistic.

Association between the characteristics of pregnant women and CED

Table 2 shows a significant relationship between parity and the CED occurrence in pregnant women (p<0.05). A significant relationship was also found between educational level and the CED occurrence in pregnant women (p<0.05). However, no statistically significant relationships were observed between age,

Table 1. The CED prevalence

CED	Frequency (n)	Percentage (%)
Not CED	254	63.2
CED	133	36.8
Total	387	100

CED: Chronic Energy Deficiency

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Table 2. Association between characteristics of pregnant women and CED

Variables	CED		Not CED		<i>p</i>
	n	%	n	%	
Age (years)					
20–35	102	36.2	180	63.8	0.270
<20 and >35	31	29.5	74	70.5	
Parity					
2–3	33	24.1	104	75.9	0.002
<2 and >3	100	40.0	150	60.0	
Infectious Disease					
No	99	32.7	204	67.3	0.229
Yes	34	40.5	50	59.5	
ANC visits					
≥4x	52	32.1	110	67.9	0.868
<4x	18	34.6	34	65.4	
Education Level					
High	39	26.7	107	73.3	0.018
Low	94	39.0	147	61.0	

ANC: Antenatal Care; CED: Chronic Energy Deficiency; *p*-value written in bold indicates a significant relationship ($p < 0.05$)

infectious disease, and ANC visits with the CED occurrence in pregnant women.

Age. Based on the current study, there is no significant relationship between age and the CED occurrence in pregnant women ($p > 0.05$). This finding is consistent with a study conducted by Novitasari *et al.* (2019), which found no statistically significant relationship between maternal age and the occurrence of CED. This could be due to the indirect relationship between age and the occurrence of CED. Other factors influencing CED occurrence include infectious disease, parity, nutritional knowledge, and dietary factors (Fitri *et al.* 2022). However, several studies found a relationship between age and CED occurrence in pregnant women. It was found that pregnant women of younger age (<20 years) or older age (>35 years) were at a higher risk of experiencing CED (Mustafa *et al.* 2021; Tejayanti 2020). Young pregnant women require additional nutrient intake not only for their growth and development but also to be allocated to support their fetal development. On the other hand, older pregnant women need higher energy intake to compensate for weakened organ functions. Therefore, both younger and older maternal age

is associated with increased nutritional needs and a higher risk of CED (Sipahutar *et al.* 2013).

Parity. Based on the current study, there is a significant relationship between parity and the occurrence of CED in pregnant women ($p < 0.05$). These findings are in line with a study conducted by Novelia *et al.* (2021), which also found a significant relationship between parity and the occurrence of CED in pregnant women ($p = 0.009$).

The most optimal pregnancies are in the 2–3 parity, while the first and more than three parity carry higher risks. Primiparous women (first-time mothers) are more likely to experience CED due to a lack of experience and knowledge, leading to less attention to their nutritional needs (Nugraha *et al.* 2019). During the first pregnancy, mothers may focus only on dealing with pregnancy-related discomforts, such as nausea, and may consume foods based on their desires without considering their increased nutritional requirements (Renjani & Misra 2017). On the other hand, a mother with high parity (having more than three children) can also contribute to conditions that affect the nutrient optimization of the mother and fetus during pregnancy,

leading to CED (Novelia *et al.* 2021). Pregnant women with high parity (grand multipara) often face difficulties caring for themselves. Usually, mothers struggle with household chores and the need to share food with family members while their nutritional needs increase (Harismayanti *et al.* 2019).

Infectious disease. Based on the bivariate analysis, it was found that there was no significant relationship between infectious diseases and CED occurrence in pregnant women ($p>0.05$). This result was suspected to be due to the CED caused by infectious diseases that was highly dependent on the severity of the infection. A study mentioned that if the infection is recent and its severity level is low, the influence on pregnant women's nutritional status is insignificant. However, if the infection becomes chronic and lasts for a long period, it can affect the nutritional status of pregnant women (Renjani & Misra 2017).

Conversely, a study found a significant association between infectious diseases and CED in pregnant women ($p=0.001$; $OR=6.171$; $95\% CI=2.155-17.675$) (Kartini 2017). It was found that infectious diseases, particularly Pulmonary Tuberculosis (TB), were the most dominant variable linked to CED among pregnant women in Indonesia in 2018. TB patients require increased energy intake to support their increased metabolism, which can lead to weight loss. Furthermore, inadequate food intake can worsen malnutrition due to decreased appetite and indigestion. The Mycobacterium tuberculosis infection triggers an inflammatory response involving cytokines release, leading to malnutrition due to lipolysis and proteolysis stimulation and increased leptin levels (Mustafa *et al.* 2021). Other infectious diseases such as Respiratory Tract Infections (RTIs) and diarrhea can also contribute to significant weight loss in pregnant women due to prolonged coughing, decreased appetite, oxidative stress, and dehydration, ultimately affecting the nutritional status of pregnant women and fetal health (Institute of Medicine 1992; Newman *et al.* 2019; Widia 2017).

ANC visits. Based on the current study, it was shown that there was no significant relationship between ANC visits and the CED occurrence in pregnant women ($p>0.05$). These findings are consistent with the studies by Lestari

(2021) and Teguh *et al.* 2019, which found no significant relationship between the frequency of ANC visits and the occurrence of CED in pregnant women.

However, another study stated that pregnant women with fewer than four ANC visits were 2.7 times more likely to experience CED ($p=0.000$; $OR=2.700$; $95\% CI=1.651-4.415$) (Fitrianiingtyas *et al.* 2018). When pregnant women receive recommended ANC visits during pregnancy, they receive additional information about their maternal health from healthcare providers. The continuity of ANC visits directly enhances their knowledge, potentially changing their perceptions and behaviors regarding the importance of adhering to healthcare provider recommendations to reduce the risk of CED (Teguh *et al.* 2019).

Education level. Based on the current study, the maternal education level has a significant relationship with the occurrence of CED in pregnant women ($p<0.05$). Consistent with the findings of this study, other studies also found a significant relationship between education level and CED occurrence in pregnant women (Nurdin *et al.* 2018; Tejayanti 2020).

A study stated that pregnant women with a low education level have a two times higher risk of experiencing CED compared to those with a higher education level (Mahirawati 2014). The higher the level of education, increase the chances to receive information, resulting in broader knowledge. Conversely, low education levels can hinder the development of an individual's attitude toward accepting new information and values (Notoatmodjo 2012). Education level plays an important role in influencing people's understanding of acquired knowledge. Generally, people with higher levels of education tend to have better knowledge. A higher level of education makes it easier for individuals to understand information and apply it to their daily behaviors and lifestyles related to health and nutrition, including understanding nutritious food for pregnant women to prevent nutritional problems (Harismayanti *et al.* 2019).

Association between household characteristics and CED

According to Table 3, it can be observed that there was a significant relationship between the transportation mode used to have access to

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Table 3. Association between household characteristics and CED

Variables	CED		Not CED		<i>p</i>
	n	%	n	%	
Residential area					
Urban	15	27.8	39	72.2	0.345
Rural	118	35.4	215	64.6	
Environmental hygiene access to a clean water source					
Minimum access (≥ 20 L)	101	32.9	206	67.1	0.354
Less than minimum (< 20 L)	31	39.2	48	60.8	
Waste management					
Good	4	21.1	15	78.9	0.322
Bad	128	34.9	239	65.1	
Access to hospital					
Transportation mode					
Motorized vehicle	83	31.4	181	68.6	0.032
Non-motorized vehicle	37	45.1	45	54.9	
Travel time					
Short time (< 60 mins)	39	28.3	99	71.1	0.054
Long time (≥ 60 mins)	81	38.9	127	61.1	
Transportation cost					
Affordable ($< 40,000$ IDR)	51	30.5	116	69.5	0.147
Not affordable ($\geq 40,000$ IDR)	69	38.5	110	61.5	
Access to primary healthcare (<i>Puskesmas</i>)					
Transportation mode					
Motorized vehicle	89	33.8	174	66.2	0.956
Non-motorized vehicle	41	34.7	77	65.3	
Travel time					
Short time (< 20 mins)	50	28.2	127	71.8	0.032
Long time (≥ 20 mins)	80	39.2	124	60.8	
Transportation cost					
Affordable ($< 10,000$ IDR)	38	29.5	91	70.5	0.208
Not affordable ($\geq 10,000$ IDR)	92	36.5	160	63.5	
Access to primary healthcare (Clinic)					
Transportation mode					
Motorized vehicle	29	21.8	104	78.2	0.397
Non-motorized vehicle	8	32.0	17	68.0	
Travel time					
Short time (< 20 mins)	12	18.8	52	81.3	0.341
Long time (≥ 20 mins)	25	26.6	69	73.4	
Transportation cost					
Affordable ($< 10,000$ IDR)	9	25.7	26	74.3	0.891
Not affordable ($\geq 10,000$ IDR)	28	22.8	95	77.2	

CED: Chronic Energy Deficiency; IDR: Indonesian Rupiah; *p*-value written in bold indicates a significant relationship ($p < 0.05$)

the hospital and the CED occurrence in pregnant women ($p < 0.05$). Additionally, the travel time to primary healthcare facilities (*Puskesmas*—a community health center in Indonesia) also showed a significant relationship with the CED occurrence in pregnant women ($p < 0.05$). However, variables such as residential area, environmental health (access to a clean water source and household waste management), travel time to the hospital, transportation costs to the hospital, transportation mode to the *Puskesmas*, transportation costs to the *Puskesmas*, transportation mode to the clinic, travel time to the clinic, and transportation cost to the clinic did not show a significant relationship with the CED occurrence in pregnant women ($p > 0.05$).

Residential area. Based on the current study, it was known that there was no significant relationship between place of residence and CED occurrence in pregnant women ($p > 0.05$). This finding is inconsistent with the results of a study conducted by (Tejayanti 2020), where a significant relationship was found between residential areas and the occurrence of CED in pregnant women ($p = 0.000$). These differences may be due to the higher proportion of respondents living in rural areas compared to those living in urban areas.

A meta-analysis and systematic review conducted in Africa stated that the risk of malnutrition is higher among pregnant women living in rural areas, with a 2.6 times higher chance of experiencing malnutrition (Desyibelew & Dadi 2019). Pregnant women experiencing nutritional problems in rural areas are more prevalent than those in urban areas due to limited access to healthcare facilities and nutrition information. A study conducted on the differences in maternal dietary intake behaviors between rural and urban environments in Poland showed that pregnant women in rural areas consume fewer high-calorie and high-protein foods compared to pregnant women in urban areas (Suliga 2015; Wojtyła *et al.* 2011).

Environmental health. Based on the current study, there is no significant relationship between access to clean water and the CED occurrence in pregnant women ($p > 0.05$). A study from Uganda stated that individuals from families using water from unprotected sources tend to have lower body weight. Lack of access to safe drinking water has a 1.7 times higher risk of experiencing underweight (Sabud *et al.*

2020). Individuals facing difficulties in accessing clean water may experience repeated episodes of diarrhea, leading to the loss of significant amounts of fluids and important nutrients, such as zinc, from their bodies. Zinc deficiency can hinder proper intestinal recovery during diarrhea episodes, resulting in malnutrition (Mshida *et al.* 2018).

Regarding household waste management, according to Table 3, there was no significant relationship between household waste management and CED occurrence in pregnant women ($p > 0.05$). A study conducted in Ethiopia found that "WASH (Water, Sanitation, and Hygiene)" behaviors can affect the risks of CED in pregnant women. The better the "WASH" behavior, the lower the proportion of mothers at risk of CED. Inadequate waste management in environmental sanitation is a primary factor leading to the emergence of infectious diseases. Infectious diseases can disrupt the body's ability to digest and absorb nutrients, resulting in weight loss. Chronic malnutrition can occur if this condition persists for a long period without adequate nutritional intake for recovery (Junanda *et al.* 2022).

Access to healthcare facilities. Based on the current study, there is a significant relationship between transportation mode to the hospital and CED occurrence in pregnant women ($p < 0.05$). Pregnant women with motorized vehicles tend to visit healthcare facilities more often. Travel time to *Puskesmas* also shows a significant relationship with CED occurrence ($p < 0.05$). However, other factors such as travel time, transportation cost, and transportation mode for different healthcare facilities do not show a significant relationship with CED occurrence ($p > 0.05$).

Accessible healthcare facilities mean that individuals can receive healthcare without being hindered by geographical and economic factors such as distance, travel time, transportation mode, transportation cost, and other barriers that may prevent them from accessing healthcare (Khatimah *et al.* 2018). Individuals with private motor vehicles tend to use healthcare facilities more than those who do not have vehicles. Transportation availability has a significant impact on the accessibility of healthcare facilities (Davy *et al.* 2016). The research findings by Masters *et al.* (2013) indicate that distance and

travel time influence pregnant women's behavior in accessing healthcare facilities.

Studies mention that the under-utilization of healthcare facilities can impact nutritional status. The easier the access to healthcare facilities for individuals, the greater the likelihood of receiving good healthcare. This condition promotes a better opportunity for appropriate management and education related to nutritional problems (Kusumawati & Rahardjo 2012).

Factor influencing the CED occurrence

Variables included in the multivariate analysis with $p \leq 0.25$ were parity, infectious disease, mothers' education level, transportation mode (hospital), travel time (hospital), transportation cost (hospital), travel time (*Puskesmas*), and transportation cost (*Puskesmas*). The model also included the age variable because, according to theory, age is associated with other variables included in the multivariate model, such as education.

After performing multivariate analysis using multiple logistic regression (Table 4), it was found that the variables significantly associated with CED were parity ($p=0.016$), education level ($p=0.036$), and travel time to the *Puskesmas* ($p=0.038$). This study found that parity was the

most influential variable to the CED occurrence in pregnant women (OR=1.868; 95% CI=1.122–3.109).

Based on the research findings, it can be concluded that parity was the most dominant variable influencing the occurrence of CED in pregnant women (OR=1.868; 95% CI=1.122–3.109). This finding indicates that women with a parity of less than two and more than three children are at a 1.8 times higher risk of experiencing CED compared to those with 2 to 3 children. Previous studies also found that CED during pregnancy can lead to Low Birth Weight (LBW) babies. Therefore, if a pregnant woman with a parity of less than two and more than three children experiences CED, the risk of giving birth to an LBW baby will be higher (Ekowati *et al.* 2017). Furthermore, according to Table 4, there were also confounding variables identified in this study: transportation mode to the hospital ($p=0.084$) and age ($p=0.070$).

Different age groups may have experienced different historical and social contexts. For example, people who were educated in earlier decades may have had different educational opportunities and experiences compared to those educated more recently. These cohort effects can influence the relationship between education

Table 4. Multiple logistic regression test results

Variable	Crude Odds Ratio (COR)				Adjusted Odds Ratio (AOR)			
	p	OR	95% CI		p	OR	95% CI	
			Lower	Upper			Lower	Upper
Parity								
<2 and >3	0.002	2.101	1.318	3.349	0.016	1.868	1.122	3.109
2–3	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Education level								
Low	0.018	1.754	1.120	2.748	0.036	1.689	1.034	2.758
High	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Transportation mode (Hospital)								
Motorized vehicle	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Non-motorized vehicle	0.032	1.793	1.080	2.976	0.084	1.588	0.939	2.758
Travel time (<i>Puskesmas</i>)								
Short time	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Long time	0.032	1.637	1.068	2.511	0.038	1.643	1.029	2.623
Age (years)								
20–35	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
<20 and >35	0.270	0.739	0.455	1.200	0.070	0.601	0.347	1.042

level and maternal nutrition because the content and quality of education may have changed over time (Raghupathi & Raghupathi 2020).

Parity can be associated with socioeconomic status, which can limit their access to transportation and healthcare. Accessing hospitals becomes challenging for individuals who do not have access to motorized transportation or reside in areas with limited public transportation options. This restricted access can result in missed healthcare appointments and subsequent delays in receiving necessary medical care (Lucas *et al.* 2008). Parity and access to healthcare are often correlated. Moreover, women with higher parity may have more children to take care of, making it challenging for them to access healthcare facilities for routine check-ups or to address health issues. On the other hand, women with lower parity may find it easier to access healthcare. This differential access can confound the relationship between parity and malnutrition if healthcare access itself is a determinant of malnutrition (Alzboon & Vural 2021).

Study strength and limitation

One of the strengths of this study is its utilization of secondary data from the Indonesia Basic Health Survey (Riskesdas) 2018, which involved a relatively large sample of 387 pregnant women. This large sample size enhances the statistical power of the study, increasing the likelihood of detecting meaningful associations and allowing for more robust conclusions to be drawn about the relationship between maternal and household characteristics and the occurrence of CED among pregnant women in the East Nusa Tenggara Province.

There may be limitations in the depth and specificity of the data available, which could have influenced the ability to explore certain risk factors or potential confounding variables in detail. Furthermore, as the study is based on cross-sectional data, it can establish associations but cannot prove causation. Thus, while the study identifies significant variables associated with CED, it cannot definitively determine causality or the temporal sequence of events. Longitudinal research may be needed to address these limitations and provide a more comprehensive understanding of the factors influencing CED among pregnant women in East Nusa Tenggara Province.

CONCLUSION

Based on the analysis results, it can be concluded that the factors significantly associated with CED occurrence among pregnant women are parity, education level, transportation mode to the hospital, and travel time to the *Puskesmas*. Factors with the greatest influence on the occurrence of CED among pregnant women are parity.

Therefore, it is recommended to consider family planning options, the number of parity, and prioritize the nutritional status of mothers before and during pregnancy to prevent CED and its consequences. Future research is suggested to use larger datasets, including energy and protein intake information, to further explore factors related to CED in pregnant women. In addition, stakeholders are encouraged to focus on infrastructure development in ENT and increase the number of healthcare facilities, ensuring better access for pregnant women.

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DECLARATION OF CONFLICT OF INTERESTS

The authors have no conflict of interest.

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