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Original Research

Determinant Factors of Chronic Energy Deficiency (CED) in Pregnant Women: A Mixed-Methods Study

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ABSTRACT

Background: *This study investigates Chronic Energy Deficiency (CED) in expecting mothers, a condition arising from prolonged inadequate energy and protein intake. Untreated CED poses health risks for both mothers and their unborn babies, including miscarriage, premature birth, birth defects, low birth weight (LBW), and potentially stunting the child's growth. Despite existing goals, the incidence of CED in pregnant women remains above the target of 17.3%. Women with a mid-upper arm circumference (MUAC) less than 23.5 cm are considered at high risk. This research aims to identify factors contributing to the prevalence of CED among pregnant women in the Central Java and East Java regions.*

Methods: *This study employs a mixed-methods approach, specifically a sequential explanatory design. A sample sized group of 124 participants was selected using simple random sampling. Questionnaires were distributed to healthcare facilities. In-depth interviews were subsequently conducted to delve deeper into the causes of CED and existing efforts to address it within the chosen health centers.*

Results: *The final multivariate analysis revealed a significant association (p-value < 0.05) between CED in pregnant women and the following factors: income (p-value=0.018, OR=3), knowledge about CED (p-value=0.028, OR=2.7), dietary habit (p-value=0.015, OR=3.4), and food intake (p-value=0.007, OR=4).*

Conclusion: *Food intake is a more dominant variable in relation to CED in pregnant women. Health workers are encouraged to continue enhancing health promotion efforts regarding nutritional intake for pregnant women and their families. In addition, community health centers should consistently support the provision of supplementary feeding programs for pregnant women through regular monitoring.*

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INTRODUCTION

CED is a prevalent nutritional issue in expectant mothers, arising from prolonged insufficient energy and protein intake. Pregnant women with a mid-upper arm circumference (MUAC) below 23.5 cm are considered high-risk for CED. This condition poses a significant health threat to both mothers and their developing babies. During pregnancy, especially the second and third trimesters, women require additional daily energy intake of 340-450 calories. A lack of essential nutrients during pregnancy can induce CED in previously healthy women and exacerbate existing CED, potentially leading to adverse outcomes (Lestari et al., 2018).

CED in expectant mothers can lead to reduced muscle strength, hindering the birthing process and potentially causing fetal distress or death (miscarriage). It can also increase the risk of premature birth, birth defects, and low birth weight (LBW) babies, and even infant mortality. Furthermore, CED can disrupt fetal growth and development, impacting physical growth (stunting), brain development, and metabolism, potentially making the child more susceptible to infectious diseases later in life (Kemenkes RI., 2018).

CED stems from inadequate intake of both macronutrients (carbohydrates, protein, and fat) and micronutrients (particularly vitamin A, D, folic acid, iron, zinc, calcium, and iodine) over a sustained period in women of childbearing age (adolescence through pregnancy). This continuous deficiency leads to CED during pregnancy. The diagnosis of CED risk or confirmed CED is often based on low energy reserves measured by MUAC (Putri & Rizka, 2020; Yunita & Ariyati, 2021). The 2018 Indonesian National Health Research Survey (Riskesdas) reported a national prevalence of CED in pregnant women at 17.3%. Notably, the prevalence is considerably higher in the provinces of Central Java (20%) and East Java (19.6%) (Riskesdas, 2018)

Several factors contribute to CED in pregnant women. Age and pregnancy history (gravida) are significant factors. Women over 35 years old are more likely to experience CED (0.576 times more risk), and grandmultigravida mothers (having had 5 or more previous pregnancies) are 3.2 times more likely to develop CED compared to primigravidas (first-time mothers) (Fatimah & Yuliani, 2019). Additionally, factors like knowledge of nutrition, dietary intake and patterns, dietary restrictions, employment status, education level, family income, and history of anemia have also been linked to the incidence of CED in expectant mothers (Suryani et al., 2021; Teguh et al., 2019; Widyawati & Sulistyoningtyas, 2020).

Motivated by these concerns, researchers aim to conduct a study to identify the contributing factors of CED in pregnant women, particularly in Central and East Java. This research seeks to analyze the causal factors influencing CED in this population to guide relevant stakeholders in developing appropriate interventions to reduce and prevent the incidence of CED in expecting mothers.

MATERIALS AND METHOD

This study follows a mixed methods approach, which combines quantitative and qualitative data collection methods. This observational design, known as Sequential Explanatory, focuses on explaining a phenomenon using both numerical data and in-depth exploration. The research was conducted in Banyumas and Mojokerto because there were quite a lot of pregnant women with KEK. Research ethics number: 1104/ EA/ KEPK/ 2023 (EC published on September 20, 2023). Pregnant women at this location were then included in the study if they were willing to participate, cooperative,

and free from infectious diseases or anemia. Meanwhile, the exclusion criteria are pregnant women who have no hands (disabled), weight <40 kg, BMI <17.00. The sample used was 124 people using the simple random sampling technique. The research instruments were LILA measurements, questionnaires on CED knowledge, Fe consumption, FFQ forms, 2x24 hour food recalls. The next stage is to dig up in-depth information regarding the causes of SEZ and the efforts that have been made in the Puskesmas Work Area on both sides (mothers with CED and community health centers).

Quantitative data analysis used Chi-square for bivariate and continued with multivariate analysis, namely multiple logistic regression. Qualitative data analysis was carried out by means of content analysis. The mixing process between quantitative and qualitative analysis occurs when it is described in the discussion of research results. The process of combining quantitative and qualitative data (mixed methods) was carried out during the discussion stage, where qualitative results were used to reinforce quantitative findings, explain contradictory findings, and triangulate data so that the interpretation of research results would be more comprehensive.

RESULTS

Results of Quantitative Research

This analysis is used to determine the frequency distribution of respondent characteristics, namely age, education, employment, parity, income:

Table 1. Characteristics of Pregnant Women in Central Java and East Java in 2023 (n = 124 women)

Variable	n	%
Age		
<20 years old	4	3.2
20-35 years old	109	87.9
>35 years old	11	8.9
Total	**124**	**100**
Education		
Higher education	93	75
Low education	31	25
Total	**124**	**100**
Work		
Work	23	18.5
Doesn't work/Housewife	101	81.5
Total	**124**	**100**
Parity		
Primigravida	56	45.2
Multigravida	68	54.8
Total	124	100
Income		
Above Regional Minimum Wage	81	65.3
Below Regional Minimum Wage	43	34.7
Total	**124**	**100**

Note: n = number of observations; % = percentage

Table 1 shows that the majority of pregnant women were aged 20-35 years, namely 109 people, with a proportion of 87.9% of the 124 respondents. At the educational level of pregnant women, the majority of the frequency of higher education was 93 people with a proportion of 75%. The majority of pregnant women do not work, namely 101 people with a proportion of 81.5%, the majority of pregnant women are multigravida, namely 68 people with a proportion of 54.8% and most of the pregnant women's family income is >UMR, namely 81 people with a proportion of 65.3%.

Table 2. Analysis of Factors Associated with CED Pregnant Women in Central Java and East Java in 2023 (n = 124 women)

Variable	CED Pregnancy						p-value*	95% CI
	Not CED		CED		Total			
	n	%	n	%	n	%		
Age								
20-35 years old	60	55.0	49	45.0	109	100	0.566	-
<20 and >35 years old	10	66.7	5	33.3	15	100		
Education								
Higher education	53	57.0	40	43.0	93	100	1.000	-
Low education	17	54.8	14	45.2	31	100		
Work								
Work	10	43.5	13	56.5	23	100	0.247	-
Doesn'twork/ Housewife	60	59.4	41	40.6	101	100		
Parity								
Primigravida	38	67.9	18	32.1	56	100	0.032	2.37
Multigravida	32	47.1	36	52.9	68	100		1.13–4.96
Income (Regional Minimum Wage)								
Above	56	69.1	25	30.9	81	100	<0.001	4.64
Below	14	32.6	29	67.4	43	100		2.09–10.26
Knowledge								
Lack of knowledge	46	71.9	18	28.1	64	100	<0.001	3.83
Good knowledge	24	40.0	36	60.0	60	100		1.81–8.12
Fe Consumption	53	55.8	42	44.2	95	100	0.956	-
Routine	17	58.6	12	41.4	29	100		
Not a routine								
Sanitation	55	56.7	42	43.3	97	100	1.000	-
Good	15	55.6	12	44.4	27	100		
Enough								
Dietary Habit	52	78.8	14	21.2	66	100	<0.001	8.25
Enough	18	31.0	40	69.0	58	100		3.67 – 18.57
Not enough								

Variable	CED Pregnancy						p-value*	95% CI
	Not CED		CED		Total			
	n	%	n	%	n	%		
Food Supply	55	76.4	17	23.6	72	100	<0.001	7.98
Enough	15	28.8	37	71.2	52	100		3.55 – 17.93
Not enough								

Note: n = number of observations; % = percentage; * Chi-square test

Based on table 2, it can be concluded that the variables (parity, income, knowledge, dietary habid and food intake) p-value <0.05, which means that the variables (parity, income, knowledge, diet and food intake) are significantly related to the incidence of CED in mothers. pregnant.

Table 3. Final Model: Analysis of Factors Associated with CED Pregnant Women in Central Java and East Java in 2023 (n = 124 women)

Variable	B	S.E.	Wald	p-value*	OR	95% CI	
						Lower	Upper
Income	1.12	0.47	5.55	0.018	3.05	1.21	7.73
Knowledge	1.01	0.46	4.82	0.028	2.74	1.11	6.72
Dietary Habit	1.22	0.50	5.89	0.015	3.39	1.27	9.13
Food Supply	1.37	0.50	7.34	0.007	3.92	1.46	10.54
Constant	-2.41	0.47	26.69	<0.001	0.09		

Note: *Multiple Logistic Regression

The final results show that the variables income, knowledge, dietary habit and food intake have a significant relationship with the incidence of CED in pregnant women (p value <0.05). Pregnant women with insufficient food intake were found to be four times more likely to develop CED compared to those with adequate food intake. Similarly, women with poor dietary practices were three and four-tenths times more likely to experience CED than those adhering to healthy dietary patterns.

Furthermore, the analysis indicated a threefold increased risk of CED among pregnant women from low-income families (below minimum wage) compared to their higher-income counterparts. Finally, the study demonstrated a two and seven-tenths times greater likelihood of CED in women with lower levels of nutritional knowledge compared to those with a stronger understanding of healthy eating habits. To see the most dominant variable, it can be seen from the OR or exp (B) value for significant variables. The greater the OR value means the greater the influence on the dependent variable being analyzed. In this case, it means that food intake has the greatest influence on pregnant women with CED.

Results of Qualitative Research

In-depth interviews with pregnant women with KEK revealed that the diets of pregnant women tend to be monotonous and low in protein and fruit intake. The following statements reinforce the quantitative research findings:

> *"Every day, I eat rice regularly 3 times a day, some vegetables, as a side dish, sometimes tofu, tempeh, eggs if available and I rarely eat fruit. Understandably my family's income is below 1.5 million if I consume meat or chicken, poor children. It contains biscuits, in*

the last 2 months ago, 2-3 pieces a day and sometimes my children at home also eat them." (Mother 1)
"Every day what I eat is rice, sometimes corn rice 2-3 times a day, I don't really like vegetables, for side dishes sometimes eggs or tofu, for meat I rarely eat because it's usually for my children, and for fruit it's usually papaya or banana. My family income is under 2 million. It contains biscuits, in the last 1 month, 2-3 pieces every day, and because it tastes delicious, sometimes my child and I eat it together." (Mother 2)

The same opinion was obtained from interviews with village midwives regarding the lack of food variety for pregnant women. The following are their statements:

"When the pregnant mother had a pregnancy check (ANC) at the KIA Polyclinic, it turned out that LILA was <23.5 cm, so we informed her that the mother had CED, so the mother would be referred to the Nutrition Polyclinic first. There usually pregnant women will be given counseling from nutrition officers and given PMT." (Midwife 1)
"Initially, pregnant women will be examined, after the results come out that the pregnant woman has KEK because LILA <23.5, then the pregnant mother will be directed to the nutrition polyclinic to be given counseling and PMT." (Midwife 2)

DISCUSSION

Based on the results of mutivariate analysis, there are four variables related to the incidence of CED in pregnant women, namely eating patterns, food intake, income and knowledge. Knowledge is the result of knowing as a result of the process of sensing certain objects through the five senses, with knowledge enabling a person to be able to solve or find solutions to the problems they face where this knowledge is obtained from direct experience or the experience of other people (Notoatmodjo, 2018). The results of the study explain that good knowledge will reduce CED in pregnant women.

Pregnant women's knowledge of nutrition is the basis for decisions in choosing food. Pregnant women who have better knowledge will tend to pay more attention to the nutritional value of the food they consume. Chronic energy deficiency that occurs in pregnant women can be influenced by the mother's diet. the pregnant. Prohibiting certain types of food from being consumed by pregnant women on the grounds that if pregnant women consume these foods it can result in defects in the babies born so that the food intake consumed by pregnant women becomes less (Putri, 2017). Due to the development of technology, currently health workers and nutritionists can provide counseling on KEK to increase the knowledge of pregnant women through online pregnancy classes (Sari et al., 2023).

Research by Retni and Puluhulawa (2021) in the Batudaa Pantai Health Center work area explains the influence of pregnant women's knowledge on the incidence of chronic energy deficiency. This is in line with Fitrianingtyas et al. (2018) regarding the relationship between knowledge and the incidence of CED in pregnant women where good knowledge is 41.8% and knowledge bad as much as 58.2%. Knowledge about the nutritional needs of pregnant women will motivate them to always consume balanced nutrition and try to prevent CED. For respondents who have low knowledge and CED does not occur, this could be because they have the habit of consuming various kinds of food every day, even though they do not know the nutritional content of these foods. This is done so that they are always healthy and there are no problems with pregnancy and the fetus's food care.

In this research there is a relationship between income and the incidence of CED in pregnancy. The quality and quantity of food in the family is determined primarily by family income. Limited family income will affect the family's inability to meet food needs. The condition of a family is greatly influenced by family income, including the health condition of family members. Families will have sufficient nutritional value if their food needs are met. Research conducted by Yunita and Ariyati (2021) in the Kertak Hanyar Health Center work area, the family income of pregnant women was significantly related to the incidence of KEK. The lower the family income, the higher the income. Research by Rahayu and Sagita (2019) at the Grogol Kediri Community Health Center found a relationship between diet and family income and the incidence of chronic energy deficiency.

The higher the income, the greater the opportunity to meet food needs by purchasing food of better quality and quantity as well. On the other hand, a decrease in income or less income will result in a higher proportion of food but a lower quality of food. Families at a low economic level will spend 60-80 percent of their total income to meet their food needs. This could mean that 70-80 percent of energy is met by food sources of carbohydrates such as cassava, rice and tubers. Only the remaining 20 percent is used to fulfill other energy sources such as fat, protein, vitamins and minerals. This condition can cause the mother to lack nutrients such as protein and others (Rahayu & Sagita, 2019; Yunita & Ariyati, 2021).

From this study, it shows that diet is significantly related to the incidence of CED in pregnant women. Diet is the amount and type of food consumed to meet the body's needs in a complete meal that is consumed every day and often prepared repeatedly. Eating patterns can be measured using the 24-hour recall method for 2 or 3 consecutive days, to calculate the consumption of energy, protein and other macro iron consumed the previous day from waking up until going back to sleep. Apart from this method, the food frequency method can also be used to obtain retrospective (past) information about eating patterns over a long period of time, for example per day, week or even month (Amalia, 2020).

Research Results Wijayanti (2019) respondents who had an adequate diet were 18 respondents or 51.4 percent, respondents who did not experience CED were 23 respondents or 65.7 percent. Apart from that, it was also seen that there was a relationship between eating patterns and the incidence of SEZ in the Gabus I Public Health Center Working Area, Pati Regency. In line with research by Yunita and Ariyati (2021) that there is a relationship between the diet of pregnant women and CED, where the poorer the diet of pregnant women, the higher the level of CED in pregnant women. This is related to the diet of pregnant women who do not implement 3 meals a day, do not consume additional fruit or biscuits or snacks outside the 3 meals a day schedule, do not consume carbohydrates other than rice in daily food consumption, fulfill nutritional needs consumed during pregnancy. not included in the balanced nutrition category, often eating fast food, not regularly consuming vitamins, and not regularly consuming fruit or vegetables as complementary foods for pregnancy.

Food intake in the form of energy and protein intake is related to the incidence of CED in pregnant women. Lack of energy intake will risk not meeting the needs of other nutrients such as protein and fat. Fat and protein will turn into an energy source if the body lacks energy. If the body lacks energy for a long time, weight loss will occur, and body tissue will begin to break down. Sufficient food substances in the body contain carbohydrates, fats and proteins which will undergo a burning process to produce

energy. If the amount of energy produced is not enough to meet the body's needs, the fat reserves in the body will be used. Protein in the liver and muscles will also be used if fat reserves are used up. This makes muscle mass thinner which can be measured by upper arm circumference (LILA) (Mangalik et al., 2019).

Pregnant women have a small energy intake, namely 36.6 percent, a small carbohydrate intake, namely 69 percent, a small protein intake, 11.3 percent, and a small fat intake, 39.4 percent. Energy and protein intake in pregnant women is significantly related to the incidence of CED in the Sukaraja Health Center Work Area, Bandar Lampung City. Energy intake is significantly related to CED pregnant women and protein intake is significantly related to CED pregnant women (Putri, 2017).

Meanwhile, carbohydrate intake was not related to CED pregnant women and fat intake was not related to CED pregnant women. Research by Harahap et al. (2019) shows that on average pregnant women who experience CED have insufficient intake, namely 62.5% (15 people). The results of statistical tests showed that the food intake of pregnant women was significantly related to chronic energy deficiency at the Simpang Tiga Health Center in Pekanbaru City. Mothers whose food intake is insufficient can indicate that their nutritional needs are not being met, so they are likely to have poor nutritional status.

The researcher's assumption is that there is a relationship between knowledge, income and food intake and dietary patterns in pregnant women. The more a mother understands the importance of nutrition during pregnancy, the greater her awareness of the importance of having a good diet. When there is an increase in income, consumers will spend their income on food in increasingly smaller portions. Conversely, if income decreases, the portion spent on food increases.

So, even if your income is low, if you have sufficient knowledge about nutritious food, there will be a balance between expenditure and the food intake needed by the body. The government and Community Health Centers have made efforts to overcome SEZ problems, such as providing counseling regarding nutritional intake and providing additional food (PMT). However, in the field there were several obstacles, such as the results in interviews that it was the children who ate the biscuits and the mother's nutritional intake was low due to sharing with the family and the average family income was still low (Mangalik et al., 2019).

The limitation of this study is that data collection for food consumption patterns was carried out using the recall method. Its success depends on the respondent's memory, the respondent's ability to convey the size and portion of food eaten accurately. Recommendations for further research using other research designs such as cohort.

CONCLUSION

The research conclusion is that knowledge, income, food intake and eating patterns are significantly related to CED pregnant women. The suggestion is that health workers continue to improve health promotion for mothers and families with attractive media so that it is easy to understand the nutritional intake that pregnant women should consume. Supplementary feeding programs can continue while monitoring.

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