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CHRONIC ENERGY DEFICIENCY AND ITS ASSOCIATIED FACTORS AMONG PREGNANT WOMEN LIVING IN RURAL AREA, INDONESIA: A COMMUNITY BASED STUDY

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ABSTRACT

Chronic energy deficiency (CED) in Indonesia is highly prevalent among pregnant women leading to become a public health problem that require immediate actions due to the adverse effects in growth and development of the fetus as well as mothers' health. This study aimed to assess factors associated with CED among pregnant women in a particular rural area in Riau Province of Indonesia. A cross sectional study was employed involving 122 pregnant women in first and second trimester from December 2024 to January 2025. Probability proportional to size (PPS) was used to select the subjects in 10 villages. Mid-Upper Arm Circumference (MUAC) was measured to determine CED incidence with less than 23.5 cm as a cut-off point. A structured questionnaire was used to collect socio-demographic, food security and food taboo. HFIAS questionnaire was performed to collect food security data. This study found that the prevalence of CED among pregnant women was 35.2%. In bivariate analysis, economic status, dietary diversity, parity, dietary pattern, food security and food taboo were found to have a significant association with CED. After adjusted by several variables using binary logistic, parity (AOR: 25.47; 95% CI:2.6- 78.23), food security (AOR: 6.19; 95% CI: 2.05- 18.73) and food taboo (AOR: 6.44; 95%CI: 2.0- 20.648) were exhibited to be determinant factors of CED with p value less than 0.05. The percentage of CED among pregnant women was higher compared to national prevalence which lead to urgent actions. Interventions targeting the causes of CED, such as parity, food security and food taboo are essential to reduce the CED incidence.

Kata Kunci:

Ibu Hamil; Kekurangan Energi Kronis; Pantangan Makanana; Ketahanan Pangan; Paritas

ABSTRAK

Kekurangan energi kronis (KEK) di Indonesia sangat umum terjadi pada Ibu hamil sehingga menjadi masalah kesehatan masyarakat yang memerlukan tindakan karena akan menimbulkan dampak yang buruk untuk pertumbuhan dan perkembangan janin serta kesehatan Ibu. Penelitian ini bertujuan untuk menganalisis faktor- faktor yang berhubungan dengan kejadian KEK pada Ibu hamil di wilayah pedesaan di Provinsi Riau, Indonesia. Studi potong lintang dilakukan dengan melibatkan 122 Ibu hamil yang berada pada trimester pertama dan kedua dari bulan Desember 2024 hingga Januari 2025. Probabilitas Proporsional Ukuran Sampling digunakan untuk memilih subjek penelitian yang berada pada 10 desa. Lingkar lengan atas (LiLa) diukur untuk menentukan kejadian KEK dengan kurang dari 23.5 cm sebagai indikator. Kuesioner terstruktur digunakan untuk mengumpulkan data sosio-demografis dan pantangan

makanan. Kuesioner HFIAS digunakan untuk mengumpulkan data ketahanan pangan. Studi ini menemukan bahwa prevalensi KEK pada ibu hamil sebesar 35,2%. Pada analisis bivariat, status ekonomi, keberagaman pangan, paritas, pola konsumsi pangan, ketahanan pangan dan pantangan makanan memiliki hubungan yang signifikan dengan KEK. Setelah di kondisikan dengan beberapa variabelmenggunakan analisis logistik binari, paritas (AOR: 25.47; 95% CI:2.6-78.23), ketahanan pangan (AOR: 6.19; 95% CI: 2.05- 18.73), dan pantangan makanan (AOR: 6.44; 95%CI: 2.0- 20.648) menjadi faktor determinan KEK dengan Pvalue < 0.05. Persentase kejadian KEK pada ibu hamil di wilayah ini lebih tinggi jika dibandingkan dengan prevalensi nasional yang membutuhkan tindakan segera. Intervensi yang menargetkan penyebab KEK, seperti paritas, ketahanan pangan, dan pantangan makanan sangat penting untuk mengurangi kejadian KEK.

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INTRODUCTION

The first one thousand days of life is a critical period that determines the next generation. If it is not utilized properly, it would cause permanent damages to the children (Setia et al., 2021). This period is started from conception until 2 years old children. Thus, maternal nutrition is required to be considered to produce a generation with optimal growth and development. However, pregnant women are prone to suffer malnutrition, particularly anaemia and chronic energy deficiency (CED). CED is a malnutrition where pregnant women had imbalance nutrition over prolonged period of time. If it occurs continuously it could inhibit the growth and development of the fetus as well as impair the immune system, causing the mother to be more susceptible to infections (K.Wati et al., 2024; Kuntari et al., 2024). Some studies also found that pregnant women with CED had higher risk to have a baby with low birth weight (Vasundhara et al., 2020; Yosefinata et al., 2022). Thus, immediate actions are required to mitigate severe outcomes in the future by addressing its risk factors.

CED can be measured using mid-upper circumference (MUAC) tape, that can be classified if the MUAC less than 23.5 cm. The measurement of maternal MUAC might assist in estimating the nutritional status of offspring that can facilitate the implementation of the measures taken to mitigate undernutrition, including risk of growth faltering and stunting in a family. Despite its feasibility, MUAC is commonly used at the national level to conduct a measurement of child and maternal nutritional status (Haque et al., 2021). According to the data from Health Survey Indonesia (SKI), the prevalence of CED among pregnant women is alarming. Even though, there was a decreasing prevalence from 17.3% in 2018 to 16.9% in 2023 (Indonesia Ministry of Health, 2018, 2023). This nutrition problem remains high. Riau is one of the provinces where most of the pregnant women experience CED, with the prevalence was above the national level (17.9%) (Indonesia Ministry of Health, 2023).

Food consumption pattern is one of the causes of CED that contributed to the lack of energy and protein intake. Individuals consumption pattern could be identified through examining their daily food intake (Puspitasari et al., 2023). Previous research indicated that Indonesia pregnant women had lower intake of both energy and protein. This was due to the existence of food taboos among pregnant women that hindered the consumption of these nutrient intake for a long time (Agustina et al., 2023). Food taboo referred to the condition that some foods were not allowed to be consumed due to several reasons such as cultural, health or individual beliefs

(Angkasa et al., 2024). These foods included seafoods, starches and certain fruits and vegetables (Mogi et al., 2024).

Moreover, pregnant women from low socioeconomic family were more likely to experience food insecurity, which makes it more difficult for them to purchase nutritious food (K.Wati et al., 2024). Most of households with food insecurity focused mainly quantity of foods consumed rather than quality, leading to alteration in dietary pattern (Ramadhani et al., 2021).

Considering the high prevalence of CED in Riau, there was a disparity regarding beliefs, attitudes, and behavior among pregnant women towards certain food consumptions. Therefore, this study aimed to examine all risk factors such as food taboo, dietary pattern, food diversity and food security with CED incidence among pregnant women in rural area of Bunga Raya district, Siak.

METHOD

Research Design

A cross sectional study was performed in Siak Regency, Riau Province, Indonesia. Data was collected on December 2024 to January 2025. Target population of this study was pregnant registered in Bunga Raya Health Centre, Siak. Inclusion criteria of the subjects were pregnant women in their first and second trimester who lived in Bunga Raya sub-district and possessing Mother Child Health (MCH) handbook

Population and Sample

The selection of sub-districts was done due to the highest prevalence of chronic energy deficiency (CED) among pregnant women. This study was conducted in 10 villages with a method probability proportional to size (PPS). There were 122 subjects participated in this study after calculated using Slovin formula.

Data Collection

CED data was obtained by measuring Mid-Upper Circumference (MUAC). It was classified as CED if the MUAC less than equal to 23,5 cm. Socio-demographic data such as education level, employment status, parity, and economic status were gathered using structured questionnaires. Dietary pattern was carried out using Food Frequency Questionnaire (FFQ) that had been validated through several process including food listing and focus group discussion among subjects with similar characteristics. The score was calculated using mean/median, depends on the data distribution. When the score was below the mean/median scores, it was classified as poor. Otherwise, when the score was above the mean/median, it was categorized as good dietary pattern. Food taboos were collected using standardized questionnaires developed by the researchers. Moreover, food diversity was obtained using 24-hour food recall which was classified as high diversity, if the subjects consumed more than 4 food groups and low diversity if the subjects consumed less than equal to 4 food groups. Food security was collected using Household Food Insecurity Access Scale (HFIAS). It was divided into 2 categories as food insecure and food secure household. Moreover, This study obtained ethical approval from Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta 5446/B.1/KEPK-FKUMS/XII/2024. All subjects agreed to be voluntarily participated and had signed an informed consent.

Data Analysis and Processing

Enumerators were recruited and selected based on their education background. Training was conducted among the enumerators regarding MUAC measurement and methods of interview by the researchers. Pre-test of questionnaire was tested on 5% of subjects outside the study area

who had similar characteristics. During data collection, supervision was undertaken by the researchers. The data were coded and analyzed using software called SPSS version 20. Characteristic respondents were analyzed using descriptive statistics and displayed using tables. Logistic regression was employed to identify factors associated with CED by including variables with p-value less than 0.25 in bivariate analysis. Adjusted odds ratio (AOR) was obtained using to indicate the strength of association with the corresponding 95% confidence interval (CI) using multiple logistic regression. At the end, variables with p-value less than 0.05 were considered as statistically significant.

RESULT

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting.(Abubakari et al., 2023; Ekowati et al., 2017) In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Table 1 presented that around 66.7% of pregnant women less than 20 years old were CED. Most of the CED subjects (87.5%) had 2 children who under 5 years old, followed by half of them were elementary school graduates. CED pregnant women who were in low-income family accounted for 70%. Regarding dietary diversity, it was profound that there was a significant relationship with CED incidence among pregnant women, in which 56.7% of them had less diverse diet. Twenty-eight (65.1%) of CED pregnant women were food insecure, almost 53.7% of them had poor dietary pattern and 66.7% were having food taboo.

Table 1 Characteristic of Subjects and Bivariate Analysis

Variables	CED	Non CED	Crude OR	P-value
	n (%)	n (%)		
Ages				
< 20 years old	6 (66.7)	3 (33.3)	2.80 (0.6-3.50)	0.096
20- 35 years old	35 (33.7)	69 (66.3)	1	
>35 years old	2 (22.2)	7 (77.8)	1.775 (0.35- 9.0)	
Parity				
< 3 times	17 (21.3)	63 (78.8)	1	0.000[a]
≥ 3 times	26 (61.9)	16 (38.1)	5.2 (3.6- 10.3)	
Education Level				
Not school	0 (0)	1 (100)		0.670
Elementary school	6 (50)	6 (50)	0.615(0.14-2.58)	
Senior High School	23 (31.5)	50 (68.5)	0.45 (0.2- 0.765)	
University	8 (38.1)	13 (61.9)	1	
Employment Status				
Housewives	37 (38.5)	67 (64.4)	1.1 (0.097- 5.32)	0.948
Civil Servants	5 (36.5)	8 (61.5)	0.92 (0.21- 4.07)	
Private Employee	1 (25)	3 (75)	1	
Economic Status				
Low income (Q1)	21 (70)	9 (30)	3.44 (1.84- 6.420)	0.000 [a]
Medium income (Q2)	16 (26.2)	45 (73.8)	1.45 (0.8- 3.50)	
High income (Q3)	6 (19.4)	25 (80.6)	1	

Dietary Diversity				
Less diverse (≤4 group)	17 (56.7)	13 (43.3)	3.32	0.009 [a]
More diverse (4 group)	26 (28.3)	66 (71.7)	(1.41- 7.79)	
Household Food Security				
Food insecure	28 (65.1)	15 (34.9)	7.9 (3.43- 18.5)	0.000 [a]
Food secure	15 (19)	64 (81)		
Dietary Pattern				
Poor	29 (53.7)	25 (46.3)	4.47 (2.02- 9.91)	0.000 [a]
Good	14 (20.6)	54 (79.4)		
Food Taboo				
Yes	26 (66.7)	13 (33.3)	7.76 (3.3- 18.22)	0.000 [a]
No	17 (20.5)	66 (79.5)		

[a]Significant association (pvalue < 0.05) using chi-square

Table 2 indicated multivariate analysis using logistic regression with parity, household food security and food taboo were the determinant factors of CED. Pregnant women who had parity more than 3 were more likely to have higher risk to suffer CED (AOR: 25.47; 95% CI:2.60- 315.06). Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73).

Table 2 Multiple Regression of CED among Pregnant Women

Variables	B	S.E	Adjusted OR (95% CI)	Pvalue
Parity				
< 3 times			1	
≥ 3 times	3.238	1.283	25.47 (2.60- 315.06)	0.012
Household Food Security				
Food secure			1	
Food insecure	1.863	0.594	6.19 (2.05- 18.73)	0.001
Food Taboo				
No			1	
Yes	1.975	0.603	6.44 (2.0- 20.648)	0.002
Constant	-5.890	1.521	0.003	0.000

Analyzed using logistic regression; Pvalue <0.05; R^2 : 0.495; adjusted by economic status, education level and employment status

DISCUSSION

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. This study aligned

with other study conducted by Angkasa et al (Angkasa et al., 2024) that there was a significant association between multiparous with CED among pregnant women. Having more than 2 times of pregnancy with close a birth distance would exacerbate the reproduction organs. While the mothers tried to recover herself by trying to consume adequate nutrient intake, conceiving again lead the mothers became malnutrition (Puspitasari et al., 2023). Food insecurity and malnutrition among pregnant women which is worsened with gender discrimination contribute to an intergenerational cycle of nutritional problems (Benson & Shekar, 2006).

In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73). This result was consistent with other studies (Motbainor et al., 2017; Mukaddas et al., 2021; Ramadhani et al., 2021). Family income is related closely with the incidence of household food insecurity which was affected the power of purchasing on nutritious foods.(Puspitasari et al., 2023) This suggested that household food security is essential for the daily consumption of all household members since it might attribute to less diverse foods as well as inequality in food distribution among the household members causing them having poor dietary intake leading to undernutrition. (Gelebo et al., 2021; Motbainor et al., 2017)

Furthermore, food taboo was found to be a determinant factor of CED among pregnant women. It was found that 66.7% of CED pregnant women was reported to have a food restriction in their community. Eggs and shrimp were the most food items restricted by the pregnant women due to several reasons such as difficulties when delivering the babies and abscess to the newborn. This findings were consistent with numerous studies that some of animal proteins and certain foods were avoided by the pregnant women (Abere & Azene, 2023; Angkasa et al., 2024; Irwan & Nurcahyani, 2024). There might be some concerns that consumption of these foods might attach to the fetal skull which lead to a larger infant and the complication on labor (Tsegaye et al., 2021). Eggs and meats are food sources that are high in protein which is required by the pregnant women to enhance the weight of the fetus. And deficiency of protein in the long run will give an impact to the cause of malnutrition to the pregnant women.

The strength of this study was strong methodology by performing PPS in the sampling which could represent the situation in that area. However, cross-sectional demonstrated in this study has a limitation that could not determine the cause and effect relationship of the study. Also, 24-hour food recall used to measure dietary diversity might cause a bias.

CONCLUSION AND SUGGESTION

This study concludes that the incidence of CED was soaring and tended to be higher compared to national prevalence in Indonesia. Parity, economic status, dietary diversity, household food security, dietary pattern and food taboo were found to be associated with CED among pregnant women. In multivariate analysis, only several variables were found to be related to CED, such as parity, household food security and food taboo. Ensuring proper nutrition of pregnant women is pivotal to avoid severe outcomes of CED by empowering health workers. Health workers should encourage to educate pregnant women about healthy food consumption during the critical growth periods of life.

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ABSTRACT

Chronic energy deficiency (CED) in Indonesia is highly prevalent among pregnant women leading to become a public health problem that require immediate actions due to the adverse effects in growth and development of the fetus as well as mothers' health. This study aimed to assess factors associated with CED among pregnant women in a particular rural area in Riau Province of Indonesia. A cross sectional study was employed involving 122 pregnant women in first and second trimester from December 2024 to January 2025. Probability proportional to size (PPS) was used to select the subjects in 10 villages. Mid-Upper Arm Circumference (MUAC) was measured to determine CED incidence with less than 23.5 cm as a cut-off point. A structured questionnaire was used to collect socio-demographic, food security and food taboo. HFIAS questionnaire was performed to collect food security data. This study found that the prevalence of CED among pregnant women was 35.2%. In bivariate analysis, economic status, dietary diversity, parity, dietary pattern, food security and food taboo were found to have a significant association with CED. After adjusted by several variables using binary logistic, parity (AOR: 25.47; 95% CI:2.6- 78.23), food security (AOR: 6.19; 95% CI: 2.05- 18.73) and food taboo (AOR: 6.44; 95%CI: 2.0- 20.648) were exhibited to be determinant factors of CED with p value less than 0.05. The percentage of CED among pregnant women was higher compared to national prevalence which lead to urgent actions. Interventions targeting the causes of CED, such as parity, food security and food taboo are essential to reduce the CED incidence.

Kata Kunci:

Ibu Hamil; Kekurangan Energi Kronis; Pantangan Makanana; Ketahanan Pangan; Paritas

ABSTRAK

Kekurangan energi kronis (KEK) di Indonesia sangat umum terjadi pada Ibu hamil sehingga menjadi masalah kesehatan masyarakat yang memerlukan tindakan karena akan menimbulkan dampak yang buruk untuk pertumbuhan dan perkembangan janin serta kesehatan Ibu. Penelitian ini bertujuan untuk menganalisis faktor- faktor yang berhubungan dengan kejadian KEK pada Ibu hamil di wilayah pedesaan di Provinsi Riau, Indonesia. Studi potong lintang dilakukan dengan melibatkan 122 Ibu hamil yang berada pada trimester pertama dan kedua dari bulan Desember 2024 hingga Januari 2025. Probabilitas Proporsional Ukuran Sampling digunakan untuk memilih subjek penelitian yang berada pada 10 desa. Lingkar lengan atas (LiLa) diukur untuk menentukan kejadian KEK dengan kurang dari 23.5 cm sebagai indikator. Kuesioner terstruktur digunakan untuk mengumpulkan data sosio-demografis dan pantangan makanan. Kuesioner HFIAS digunakan untuk mengumpulkan data ketahanan pangan. Studi ini menemukan bahwa prevalensi KEK pada ibu hamil sebesar 35,2%. Pada analisis bivariat, status ekonomi, keberagaman pangan, paritas, pola konsumsi pangan, ketahanan pangan dan pantangan makanan memiliki hubungan yang signifikan dengan KEK. Setelah di kondisikan dengan beberapa variabelmenggunakan analisis logistik binari, paritas (AOR: 25.47; 95% CI:2.6-78.23), ketahanan pangan (AOR: 6.19; 95% CI: 2.05- 18.73), dan pantangan makanan (AOR: 6.44; 95%CI: 2.0- 20.648) menjadi faktor determinan KEK dengan Pvalue < 0.05. Persentase kejadian KEK pada ibu hamil di wilayah ini lebih tinggi jika dibandingkan dengan prevalensi nasional yang membutuhkan tindakan

segera. Intervensi yang menargetkan penyebab KEK, seperti paritas, ketahanan pangan, dan pantangan makanan sangat penting untuk mengurangi kejadian KEK.

✉ ***Corresponding Author:***

INTRODUCTION

The first one thousand days of life is a critical period that determines the next generation. If it is not utilized properly, it would cause permanent damages to the children (Setia et al., 2021). This period is started from conception until 2 years old children. Thus, maternal nutrition is required to be considered to produce a generation with optimal growth and development. However, pregnant women are prone to suffer malnutrition, particularly anaemia and chronic energy deficiency (CED). CED is a malnutrition where pregnant women had imbalance nutrition over prolonged period of time. If it occurs continuously it could inhibit the growth and development of the fetus as well as impair the immune system, causing the mother to be more susceptible to infections (K.Wati et al., 2024; Kuntari et al., 2024). Some studies also found that pregnant women with CED had higher risk to have a baby with low birth weight (Vasundhara et al., 2020; Yosefinata et al., 2022). Thus, immediate actions are required to mitigate severe outcomes in the future by addressing its risk factors.

CED can be measured using mid-upper circumference (MUAC) tape, that can be classified if the MUAC less than 23.5 cm. The measurement of maternal MUAC might assist in estimating the nutritional status of offspring that can facilitate the implementation of the measures taken to mitigate undernutrition, including risk of growth faltering and stunting in a family. Despite its feasibility, MUAC is commonly used at the national level to conduct a measurement of child and maternal nutritional status (Haque et al., 2021). According to the data from Health Survey Indonesia (SKI), the prevalence of CED among pregnant women is alarming. Even though, there was a decreasing prevalence from 17.3% in 2018 to 16.9% in 2023 (Indonesia Ministry of Health, 2018, 2023). This nutrition problem remains high. Riau is one of the provinces where most of the pregnant women experience CED, with the prevalence was above the national level (17.9%) (Indonesia Ministry of Health, 2023).

Food consumption pattern is one of the causes of CED that contributed to the lack of energy and protein intake. Individuals consumption pattern could be identified through examining their daily food intake (Puspitasari et al., 2023). Previous research indicated that Indonesia pregnant women had lower intake of both energy and protein. This was due to the existence of food taboos among pregnant women that hindered the consumption of these nutrient intake for a long time (Agustina et al., 2023). Food taboo referred to the condition that some foods were not allowed to be consumed due to several reasons such as cultural, health or individual beliefs (Angkasa et al., 2024). These foods included seafoods, starches and certain fruits and vegetables (Mogi et al., 2024).

Moreover, pregnant women from low socioeconomic family were more likely to experience food insecurity, which makes it more difficult for them to purchase nutritious food (K.Wati et

al., 2024). Most of households with food insecurity focused mainly quantity of foods consumed rather than quality, leading to alteration in dietary pattern (Ramadhani et al., 2021).
Considering the high prevalence of CED in Riau, there was a disparity regarding beliefs, attitudes, and behavior among pregnant women towards certain food consumptions. Therefore, this study aimed to examine all risk factors such as food taboo, dietary pattern, food diversity and food security with CED incidence among pregnant women in rural area of Bunga Raya district, Siak.

METHOD

Research Design

A cross sectional study was performed in Siak Regency, Riau Province, Indonesia. Data was collected on December 2024 to January 2025. Target population of this study was pregnant registered in Bunga Raya Health Centre, Siak. Inclusion criteria of the subjects were pregnant women in their first and second trimester who lived in Bunga Raya sub-district and possessing Mother Child Health (MCH) handbook

Population and Sample

The selection of sub-districts was done due to the highest prevalence of chronic energy deficiency (CED) among pregnant women. This study was conducted in 10 villages with a method probability proportional to size (PPS). There were 122 subjects participated in this study after calculated using Slovin formula.

Data Collection

CED data was obtained by measuring Mid-Upper Circumference (MUAC). It was classified as CED if the MUAC less than equal to 23,5 cm. Socio-demographic data such as education level, employment status, parity, and economic status were gathered using structured questionnaires. Dietary pattern was carried out using Food Frequency Questionnaire (FFQ) that had been validated through several process including food listing and focus group discussion among subjects with similar characteristics. The score was calculated using mean/median, depends on the data distribution. When the score was below the mean/median scores, it was classified as poor. Otherwise, when the score was above the mean/median, it was categorized as good dietary pattern. Food taboos were collected using standardized questionnaires developed by the researchers. Moreover, food diversity was obtained using 24-hour food recall which was classified as high diversity, if the subjects consumed more than 4 food groups and low diversity if the subjects consumed less than equal to 4 food groups. Food security was collected using Household Food Insecurity Access Scale (HFIAS). It was divided into 2 categories as food insecure and food secure household. Moreover, This study obtained ethical approval from Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta 5446/B.1/KEPK-FKUMS/XII/2024. All subjects agreed to be voluntarily participated and had signed an informed consent.

Data Analysis and Processing

Enumerators were recruited and selected based on their education background. Training was conducted among the enumerators regarding MUAC measurement and methods of interview by the researchers. Pre-test of questionnaire was tested on 5% of subjects outside the study area who had similar characteristics. During data collection, supervision was undertaken by the researchers. The data were coded and analyzed using software called SPSS version 20. Characteristic respondents were analyzed using descriptive statistics and displayed using tables. Logistic regression was employed to identify factors associated with CED by including

variables with p-value less than 0.25 in bivariate analysis. Adjusted odds ratio (AOR) was obtained using to indicate the strength of association with the corresponding 95% confidence interval (CI) using multiple logistic regression. At the end, variables with p-value less than 0.05 were considered as statistically significant.

RESULT

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting.(Abubakari et al., 2023; Ekowati et al., 2017) In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Table 1 presented that around 66.7% of pregnant women less than 20 years old were CED. Most of the CED subjects (87.5%) had 2 children who under 5 years old, followed by half of them were elementary school graduates. CED pregnant women who were in low-income family accounted for 70%. Regarding dietary diversity, it was profound that there was a significant relationship with CED incidence among pregnant women, in which 56.7% of them had less diverse diet. Twenty-eight (65.1%) of CED pregnant women were food insecure, almost 53.7% of them had poor dietary pattern and 66.7% were having food taboo.

Table 1 Characteristic of Subjects and Bivariate Analysis

Variables	CED	Non CED	Crude OR	P-value
	n (%)	n (%)		
Ages				
< 20 years old	6 (66.7)	3 (33.3)	2.80 (0.6-3.50)	0.096
20- 35 years old	35 (33.7)	69 (66.3)	1	
>35 years old	2 (22.2)	7 (77.8)	1.775 (0.35- 9.0)	
Parity				
< 3 times	17 (21.3)	63 (78.8)	1	0.000[a]
≥ 3 times	26 (61.9)	16 (38.1)	5.2 (3.6- 10.3)	
Education Level				
Not school	0 (0)	1 (100)		0.670
Elementary school	6 (50)	6 (50)	0.615(0.14-2.58)	
Senior High School	23 (31.5)	50 (68.5)	0.45 (0.2- 0.765)	
University	8 (38.1)	13 (61.9)	1	
Employment Status				
Housewives	37 (38.5)	67 (64.4)	1.1 (0.097- 5.32)	0.948
Civil Servants	5 (36.5)	8 (61.5)	0.92 (0.21- 4.07)	
Private Employee	1 (25)	3 (75)	1	
Economic Status				
Low income (Q1)	21 (70)	9 (30)	3.44 (1.84- 6.420)	0.000 [a]
Medium income (Q2)	16 (26.2)	45 (73.8)	1.45 (0.8- 3.50)	
High income (Q3)	6 (19.4)	25 (80.6)	1	
Dietary Diversity				
Less diverse (≤4 group)	17 (56.7)	13 (43.3)	3.32	0.009 [a]
More diverse (4 group)	26 (28.3)	66 (71.7)	(1.41- 7.79)	
Household Food Security				

Food insecure	28 (65.1)	15 (34.9)	7.9 (3.43- 18.5)	0.000 [a]
Food secure	15 (19)	64 (81)		
Dietary Pattern				
Poor	29 (53.7)	25 (46.3)	4.47 (2.02- 9.91)	0.000 [a]
Good	14 (20.6)	54 (79.4)		
Food Taboo				
Yes	26 (66.7)	13 (33.3)	7.76 (3.3- 18.22)	0.000 [a]
No	17 (20.5)	66 (79.5)		

[a]Significant association (pvalue < 0.05) using chi-square

Table 2 indicated multivariate analysis using logistic regression with parity, household food security and food taboo were the determinant factors of CED. Pregnant women who had parity more than 3 were more likely to have higher risk to suffer CED (AOR: 25.47; 95% CI:2.60- 315.06). Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73).

Table 2 Multiple Regression of CED among Pregnant Women

Variables	B	S.E	Adjusted OR (95% CI)	Pvalue
Parity				
< 3 times			1	
≥ 3 times	3.238	1.283	25.47 (2.60- 315.06)	0.012
Household Food Security				
Food secure			1	
Food insecure	1.863	0.594	6.19 (2.05- 18.73)	0.001
Food Taboo				
No			1	
Yes	1.975	0.603	6.44 (2.0- 20.648)	0.002
Constant	-5.890	1.521	0.003	0.000

Analyzed using logistic regression; Pvalue <0.05; R^2 : 0.495; adjusted by economic status, education level and employment status

DISCUSSION

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. This study aligned with other study conducted by Angkasa et al (Angkasa et al., 2024) that there was a significant association between multiparous with CED among pregnant women. Having more than 2 times of pregnancy with close a birth distance would exacerbate the reproduction organs. While the mothers tried to recover herself by trying to consume adequate nutrient intake, conceiving again

lead the mothers became malnutrition (Puspitasari et al., 2023). Food insecurity and malnutrition among pregnant women which is worsened with gender discrimination contribute to an intergenerational cycle of nutritional problems (Benson & Shekar, 2006).

In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73). This result was consistent with other studies (Motbainor et al., 2017; Mukaddas et al., 2021; Ramadhani et al., 2021). Family income is related closely with the incidence of household food insecurity which was affected the power of purchasing on nutritious foods.(Puspitasari et al., 2023) This suggested that household food security is essential for the daily consumption of all household members since it might attribute to less diverse foods as well as inequality in food distribution among the household members causing them having poor dietary intake leading to undernutrition. (Gelebo et al., 2021; Motbainor et al., 2017)

Furthermore, food taboo was found to be a determinant factor of CED among pregnant women. It was found that 66.7% of CED pregnant women was reported to have a food restriction in their community. Eggs and shrimp were the most food items restricted by the pregnant women due to several reasons such as difficulties when delivering the babies and abscess to the newborn. This findings were consistent with numerous studies that some of animal proteins and certain foods were avoided by the pregnant women (Abere & Azene, 2023; Angkasa et al., 2024; Irwan & Nurcahyani, 2024). There might be some concerns that consumption of these foods might attach to the fetal skull which lead to a larger infant and the complication on labor (Tsegaye et al., 2021). Eggs and meats are food sources that are high in protein which is required by the pregnant women to enhance the weight of the fetus. And deficiency of protein in the long run will give an impact to the cause of malnutrition to the pregnant women.

The strength of this study was strong methodology by performing PPS in the sampling which could represent the situation in that area. However, cross-sectional demonstrated in this study has a limitation that could not determine the cause and effect relationship of the study. Also, 24-hour food recall used to measure dietary diversity might cause a bias.

CONCLUSION AND SUGGESTION

This study concludes that the incidence of CED was soaring and tended to be higher compared to national prevalence in Indonesia. Parity, economic status, dietary diversity, household food security, dietary pattern and food taboo were found to be associated with CED among pregnant women. In multivariate analysis, only several variables were found to be related to CED, such as parity, household food security and food taboo. Ensuring proper nutrition of pregnant women is pivotal to avoid severe outcomes of CED by empowering health workers. Health workers should encourage to educate pregnant women about healthy food consumption during the critical growth periods of life.

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Dewi Anggriani Harahap (dewianggriani)

Messages

Note	From
Mrs. Irma Muslimin Editor-in-chief Jurnal Kesehatan Manarang	dewianggriani 2025-04-03 05:57 AM

Dear Mrs. Irma Muslimin,

We wish to submit original research entitled "**Chronic Energy Deficiency and Its Associated Factors among Pregnant Women Living in Rural Area, Indonesia: A Community Based Study"** for consideration by Jurnal Kesehatan Manarang. We confirm that this work is original research and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

We performed research to examine the determinant factors of chronic energy deficiency (CED) among pregnant women in Riau. Pregnant women are one of vulnerable groups that should be paid attention very well since they are prone to suffer malnutrition. This study enrolled 122 pregnant women in 1st and 2nd trimester. It was found that some variables were significantly associated with CED, including parity, household food security and food taboo.

We believe the findings presented in our paper are predominant and timely for publication by Jurnal Kesehatan Manarang as it is aligned with the scope area of its journal. Food taboo is common among pregnant women, particularly for those living in rural area. Considering this situation, it may

publication elsewhere.

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We believe the findings presented in our paper are predominant and timely for publication by Jurnal Kesehatan Manarang as it is aligned with the scope area of its journal. Food taboo is common among pregnant women, particularly for those living in rural area. Considering this situation, it may affect the nutrient adequacy among these populations. Thus, this research highlighted an important information on food taboo as well as suggestion for further actions.

We have no conflict of interest to disclose. Data described in the manuscript will be made available from the corresponding author on reasonable request. Please address all correspondence concerning this manuscript to Dewi Anggriani Harahap, M.Keb, as the corresponding author at anggie.dwh@gmail.com .

Thank you for your consideration of this manuscript.

Sincerely yours,

Dewi Anggriani Harahap, M.Keb

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Universitas Pahlawan Tuanku Tambusai

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CHRONIC ENERGY DEFICIENCY AND ITS ASSOCIATIED FACTORS AMONG PREGNANT WOMEN LIVING IN RURAL AREA, INDONESIA: A COMMUNITY BASED STUDY

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Pregnant women; Chronic Energy Deficiency; Food Taboo; Food Security; Parity

ABSTRACT

Chronic energy deficiency (CED) in Indonesia is highly prevalent among pregnant women leading to become a public health problem that require immediate actions due to the adverse effects in growth and development of the fetus as well as mothers' health. This study aimed to assess factors associated with CED among pregnant women in a particular rural area in Riau Province of Indonesia. A cross sectional study was employed involving 122 pregnant women in first and second trimester from December 2024 to January 2025. Probability proportional to size (PPS) was used to select the subjects in 10 villages. Mid-Upper Arm Circumference (MUAC) was measured to determine CED incidence with less than 23.5 cm as a cut-off point. A structured questionnaire was used to collect socio-demographic, food security and food taboo. HFIAS questionnaire was performed to collect food security data. This study found that the prevalence of CED among pregnant women was 35.2%. In bivariate analysis, economic status, dietary diversity, parity, dietary pattern, food security and food taboo were found to have a significant association with CED. After adjusted by several variables using binary logistic, parity (AOR: 25.47; 95% CI:2.6- 78.23), food security (AOR: 6.19; 95% CI: 2.05- 18.73) and food taboo (AOR: 6.44; 95%CI: 2.0- 20.648) were exhibited to be determinant factors of CED with p value less than 0.05. The percentage of CED among pregnant women was higher compared to national prevalence which lead to urgent actions. Interventions targeting the causes of CED, such as parity, food security and food taboo are essential to reduce the CED incidence.

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Kata Kunci:

Ibu Hamil; Kekurangan Energi Kronis; Pantangan Makanana; Ketahanan Pangan; Paritas

ABSTRAK

Kekurangan energi kronis (KEK) di Indonesia sangat umum terjadi pada Ibu hamil sehingga menjadi masalah kesehatan masyarakat yang memerlukan tindakan karena akan menimbulkan dampak yang buruk untuk pertumbuhan dan perkembangan janin serta kesehatan Ibu. Penelitian ini bertujuan untuk menganalisis faktor- faktor yang berhubungan dengan kejadian KEK pada Ibu hamil di wilayah pedesaan di Provinsi Riau, Indonesia. Studi potong lintang dilakukan dengan melibatkan 122 Ibu hamil yang berada pada trimester pertama dan kedua dari bulan Desember 2024 hingga Januari 2025. Probabilitas Proporsional Ukuran Sampling digunakan untuk memilih subjek penelitian yang berada pada 10 desa. Lingkar lengan atas (LiLa) diukur untuk menentukan kejadian KEK dengan kurang dari 23.5 cm sebagai indikator. Kuesioner terstruktur digunakan untuk mengumpulkan data sosio-demografis dan pantangan makanan. Kuesioner HFIAS digunakan untuk mengumpulkan data ketahanan pangan. Studi ini menemukan bahwa prevalensi KEK pada ibu hamil sebesar 35,2%. Pada analisis bivariat, status ekonomi, keberagaman pangan, paritas, pola konsumsi pangan, ketahanan pangan dan pantangan makanan memiliki hubungan yang signifikan dengan KEK. Setelah di kondisikan dengan beberapa variabelmenggunakan analisis logistik binari, paritas (AOR: 25.47; 95% CI:2.6-78.23), ketahanan pangan (AOR: 6.19; 95% CI: 2.05- 18.73), dan pantangan makanan (AOR: 6.44; 95%CI: 2.0- 20.648) menjadi faktor determinan KEK dengan Pvalue < 0.05. Persentase kejadian KEK pada ibu hamil di wilayah ini lebih tinggi jika dibandingkan dengan prevalensi nasional yang membutuhkan tindakan

segera. Intervensi yang menargetkan penyebab KEK, seperti paritas, ketahanan pangan, dan pantangan makanan sangat penting untuk mengurangi kejadian KEK.

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INTRODUCTION

The first one thousand days of life is a critical period that determines the next generation. If it is not utilized properly, it would cause permanent damages to the children (Setia et al., 2021). This period is started from conception until 2 years old children. Thus, maternal nutrition is required to be considered to produce a generation with optimal growth and development. However, pregnant women are prone to suffer malnutrition, particularly anaemia and chronic energy deficiency (CED). CED is a malnutrition where pregnant women had imbalance nutrition over prolonged period of time. If it occurs continuously it could inhibit the growth and development of the fetus as well as impair the immune system, causing the mother to be more susceptible to infections (K.Wati et al., 2024; Kuntari et al., 2024). Some studies also found that pregnant women with CED had higher risk to have a baby with low birth weight (Vasundhara et al., 2020; Yosefinata et al., 2022). Thus, immediate actions are required to mitigate severe outcomes in the future by addressing its risk factors.

CED can be measured using mid-upper circumference (MUAC) tape, that can be classified if the MUAC less than 23.5 cm. The measurement of maternal MUAC might assist in estimating the nutritional status of offspring that can facilitate the implementation of the measures taken to mitigate undernutrition, including risk of growth faltering and stunting in a family. Despite its feasibility, MUAC is commonly used at the national level to conduct a measurement of child and maternal nutritional status (Haque et al., 2021). According to the data from Health Survey Indonesia (SKI), the prevalence of CED among pregnant women is alarming. Even though, there was a decreasing prevalence from 17.3% in 2018 to 16.9% in 2023 (Indonesia Ministry of Health, 2018, 2023). This nutrition problem remains high. Riau is one of the provinces where most of the pregnant women experience CED, with the prevalence was above the national level (17.9%) (Indonesia Ministry of Health, 2023).

Food consumption pattern is one of the causes of CED that contributed to the lack of energy and protein intake. Individuals consumption pattern could be identified through examining their daily food intake (Puspitasari et al., 2023). Previous research indicated that Indonesia pregnant women had lower intake of both energy and protein. This was due to the existence of food taboos among pregnant women that hindered the consumption of these nutrient intake for a long time (Agustina et al., 2023). Food taboo referred to the condition that some foods were not allowed to be consumed due to several reasons such as cultural, health or individual beliefs (Angkasa et al., 2024). These foods included seafoods, starches and certain fruits and vegetables (Mogi et al., 2024).

Moreover, pregnant women from low socioeconomic family were more likely to experience food insecurity, which makes it more difficult for them to purchase nutritious food (K.Wati et

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For example, the phrase "CED is a malnutrition where pregnant women had imbalance nutrition over prolonged period of time" could be better stated as "CED is a form of malnutrition characterized by prolonged inadequate energy intake leading to nutritional imbalance in pregnant women."

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al., 2024). Most of households with food insecurity focused mainly quantity of foods consumed rather than quality, leading to alteration in dietary pattern (Ramadhani et al., 2021).
Considering the high prevalence of CED in Riau, there was a disparity regarding beliefs, attitudes, and behavior among pregnant women towards certain food consumptions. Therefore, this study aimed to examine all risk factors such as food taboo, dietary pattern, food diversity and food security with CED incidence among pregnant women in rural area of Bunga Raya district, Siak.

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After describing the research gap, give the problem statement, followed by the research aim at the end of this paragraph. In this way, readers will understand the urgency of this paper and what to expect in the following sections.

METHOD

Research Design

A cross sectional study was performed in Siak Regency, Riau Province, Indonesia. Data was collected on December 2024 to January 2025. Target population of this study was pregnant registered in Bunga Raya Health Centre, Siak. Inclusion criteria of the subjects were pregnant women in their first and second trimester who lived in Bunga Raya sub-district and possessing Mother Child Health (MCH) handbook

Population and Sample

The selection of sub-districts was done due to the highest prevalence of chronic energy deficiency (CED) among pregnant women. This study was conducted in 10 villages with a method probability proportional to size (PPS). There were 122 subjects who participated in this study after being calculated using the Sollins formula.

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Data Collection

CED data was obtained by measuring Mid-Upper Circumference (MUAC). It was classified as CED if the MUAC less than equal to 23,5 cm. Socio-demographic data such as education level, employment status, parity, and economic status were gathered using structured questionnaires. Dietary pattern was carried out using Food Frequency Questionnaire (FFQ) that had been validated through several process including food listing and focus group discussion among subjects with similar characteristics. The score was calculated using mean/median, depends on the data distribution. When the score was below the mean/median scores, it was classified as poor. Otherwise, when the score was above the mean/median, it was categorized as good dietary pattern. Food taboos were collected using standardized questionnaires developed by the researchers. Moreover, food diversity was obtained using 24-hour food recall which was classified as high diversity, if the subjects consumed more than 4 food groups and low diversity if the subjects consumed less than equal to 4 food groups. Food security was collected using Household Food Insecurity Access Scale (HFIAS). It was divided into 2 categories as food insecure and food secure household. Moreover, This study obtained ethical approval from Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta 5446/B.1/KEPK-FKUMS/XII/2024. All subjects agreed to be voluntarily participated and had signed an informed consent.

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Additionally, some grammatical errors were identified in this paragraph. Suggest revision.

Data Analysis and Processing

Enumerators were recruited and selected based on their education background. Training was conducted among the enumerators regarding MUAC measurement and methods of interview by the researchers. Pre-test of questionnaire was tested on 5% of subjects outside the study area who had similar characteristics. During data collection, supervision was undertaken by the researchers. The data were coded and analyzed using software called SPSS version 20. Characteristic respondents were analyzed using descriptive statistics and displayed using tables. Logistic regression was employed to identify factors associated with CED by including

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variables with p-value less than 0.25 in bivariate analysis. Adjusted odds ratio (AOR) was obtained using to indicate the strength of association with the corresponding 95% confidence interval (CI) using multiple logistic regression. At the end, variables with p-value less than 0.05 were considered as statistically significant.

RESULT

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting.(Abubakari et al., 2023; Ekowati et al., 2017) In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Table 1 presented that around 66.7% of pregnant women less than 20 years old were CED. Most of the CED subjects (87.5%) had 2 children who under 5 years old, followed by half of them were elementary school graduates. CED pregnant women who were in low-income family accounted for 70%. Regarding dietary diversity, it was profound that there was a significant relationship with CED incidence among pregnant women, in which 56.7% of them had less diverse diet. Twenty-eight (65.1%) of CED pregnant women were food insecure, almost 53.7% of them had poor dietary pattern and 66.7% were having food taboo.

Table 1 Characteristic of Subjects and Bivariate Analysis

Variables	CED	Non CED	Crude OR	P-value
	n (%)	n (%)		
Ages				
< 20 years old	6 (66.7)	3 (33.3)	2.80 (0.6-3.50)	0.096
20- 35 years old	35 (33.7)	69 (66.3)	1	
>35 years old	2 (22.2)	7 (77.8)	1.775 (0.35- 9.0)	
Parity				
< 3 times	17 (21.3)	63 (78.8)	1	0.000[a]
≥ 3 times	26 (61.9)	16 (38.1)	5.2 (3.6- 10.3)	
Education Level				
Not school	0 (0)	1 (100)		0.670
Elementary school	6 (50)	6 (50)	0.615(0.14-2.58)	
Senior High School	23 (31.5)	50 (68.5)	0.45 (0.2- 0.765)	
University	8 (38.1)	13 (61.9)	1	
Employment Status				
Housewives	37 (38.5)	67 (64.4)	1.1 (0.097- 5.32)	0.948
Civil Servants	5 (36.5)	8 (61.5)	0.92 (0.21- 4.07)	
Private Employee	1 (25)	3 (75)	1	
Economic Status				
Low income (Q1)	21 (70)	9 (30)	3.44 (1.84- 6.420)	0.000 [a]
Medium income (Q2)	16 (26.2)	45 (73.8)	1.45 (0.8- 3.50)	
High income (Q3)	6 (19.4)	25 (80.6)	1	
Dietary Diversity				
Less diverse (≤4 group)	17 (56.7)	13 (43.3)	3.32	0.009 [a]
More diverse (4 group)	26 (28.3)	66 (71.7)	(1.41- 7.79)	
Household Food Security				

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Food insecure	28 (65.1)	15 (34.9)	7.9 (3.43- 18.5)	0.000 [a]
Food secure	15 (19)	64 (81)		
Dietary Pattern				
Poor	29 (53.7)	25 (46.3)	4.47 (2.02- 9.91)	0.000 [a]
Good	14 (20.6)	54 (79.4)		
Food Taboo				
Yes	26 (66.7)	13 (33.3)	7.76 (3.3- 18.22)	0.000 [a]
No	17 (20.5)	66 (79.5)		

[a]Significant association (pvalue < 0.05) using chi-square

Table 2 indicated multivariate analysis using logistic regression with parity, household food security and food taboo were the determinant factors of CED. Pregnant women who had parity more than 3 were more likely to have higher risk to suffer CED (AOR: 25.47; 95% CI:2.60- 315.06). Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73).

Table 2 Multiple Regression of CED among Pregnant Women

Variables	B	S.E	Adjusted OR (95% CI)	Pvalue
Parity				
< 3 times			1	
≥ 3 times	3.238	1.283	25.47 (2.60- 315.06)	0.012
Household Food Security				
Food secure			1	
Food insecure	1.863	0.594	6.19 (2.05- 18.73)	0.001
Food Taboo				
No			1	
Yes	1.975	0.603	6.44 (2.0- 20.648)	0.002
Constant	-5.890	1.521	0.003	0.000

Analyzed using logistic regression; Pvalue <0.05; R^2 : 0.495; adjusted by economic status, education level and employment status

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DISCUSSION

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

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Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. This study aligned with other study conducted by Angkasa et al (Angkasa et al., 2024) that there was a significant association between multiparous with CED among pregnant women. Having more than 2 times of pregnancy with close a birth distance would exacerbate the reproduction organs. While the mothers tried to recover herself by trying to consume adequate nutrient intake, conceiving again

lead the mothers became malnutrition (Puspitasari et al., 2023). Food insecurity and malnutrition among pregnant women which is worsened with gender discrimination contribute to an intergenerational cycle of nutritional problems (Benson & Shekar, 2006).

In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73). This result was consistent with other studies (Motbainor et al., 2017; Mukaddas et al., 2021; Ramadhani et al., 2021). Family income is related closely with the incidence of household food insecurity which was affected the power of purchasing on nutritious foods.(Puspitasari et al., 2023) This suggested that household food security is essential for the daily consumption of all household members since it might attribute to less diverse foods as well as inequality in food distribution among the household members causing them having poor dietary intake leading to undernutrition. (Gelebo et al., 2021; Motbainor et al., 2017)

Furthermore, food taboo was found to be a determinant factor of CED among pregnant women. It was found that 66.7% of CED pregnant women was reported to have a food restriction in their community. Eggs and shrimp were the most food items restricted by the pregnant women due to several reasons such as difficulties when delivering the babies and abscess to the newborn. This findings were consistent with numerous studies that some of animal proteins and certain foods were avoided by the pregnant women (Abere & Azene, 2023; Angkasa et al., 2024; Irwan & Nurcahyani, 2024). There might be some concerns that consumption of these foods might attach to the fetal skull which lead to a larger infant and the complication on labor (Tsegaye et al., 2021). Eggs and meats are food sources that are high in protein which is required by the pregnant women to enhance the weight of the fetus. And deficiency of protein in the long run will give an impact to the cause of malnutrition to the pregnant women.

The strength of this study was strong methodology by performing PPS in the sampling which could represent the situation in that area. However, cross-sectional demonstrated in this study has a limitation that could not determine the cause and effect relationship of the study. Also, 24-hour food recall used to measure dietary diversity might cause a bias.

CONCLUSION AND SUGGESTION

This study concludes that the incidence of CED was soaring and tended to be higher compared to national prevalence in Indonesia. Parity, economic status, dietary diversity, household food security, dietary pattern and food taboo were found to be associated with CED among pregnant women. In multivariate analysis, only several variables were found to be related to CED, such as parity, household food security and food taboo. Ensuring proper nutrition of pregnant women is pivotal to avoid severe outcomes of CED by empowering health workers. Health workers should encourage to educate pregnant women about healthy food consumption during the critical growth periods of life.

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Consider giving a deeper explanation of the biological and social mechanisms underlying parity-CED relationships. For example, how high parity and short birth intervals biologically and nutritionally contribute to maternal depletion would strengthen the interpretation.

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CHRONIC ENERGY DEFICIENCY AND ITS ASSOCIATIED FACTORS AMONG PREGNANT WOMEN LIVING IN RURAL AREA, INDONESIA: A COMMUNITY BASED STUDY

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Chronic energy deficiency (CED) in Indonesia is highly prevalent among pregnant women leading to become a public health problem that require immediate actions due to the adverse effects in growth and development of the fetus as well as mothers' health. This study aimed to assess factors associated with CED among pregnant women in a particular rural area in Riau Province of Indonesia. A cross sectional study was employed involving 122 pregnant women in first and second trimester from December 2024 to January 2025. Probability proportional to size (PPS) was used to select the subjects in 10 villages. Mid-Upper Arm Circumference (MUAC) was measured to determine CED incidence with less than 23.5 cm as a cut-off point. A structured questionnaire was used to collect socio-demographic, food security and food taboo. HFIAS questionnaire was performed to collect food security data. This study found that the prevalence of CED among pregnant women was 35.2%. In bivariate analysis, economic status, dietary diversity, parity, dietary pattern, food security and food taboo were found to have a significant association with CED. After adjusted by several variables using binary logistic, parity (AOR: 25.47; 95% CI:2.6- 78.23), food security (AOR: 6.19; 95% CI: 2.05- 18.73) and food taboo (AOR: 6.44; 95%CI: 2.0- 20.648) were exhibited to be determinant factors of CED with p value less than 0.05. The percentage of CED among pregnant women was higher compared to national prevalence which lead to urgent actions. Interventions targeting the causes of CED, such as parity, food security and food taboo are essential to reduce the CED incidence.

Commented [AM1]: Briefly mention the specific characteristics of the "rural area in Riau Province" (e.g., primary economic activity, cultural context if relevant to food taboos) to provide context.

Kata Kunci:

Ibu Hamil; Kekurangan Energi Kronis; Pantangan Makanana; Ketahanan Pangan; Paritas

ABSTRAK

Kekurangan energi kronis (KEK) di Indonesia sangat umum terjadi pada Ibu hamil sehingga menjadi masalah kesehatan masyarakat yang memerlukan tindakan karena akan menimbulkan dampak yang buruk untuk pertumbuhan dan perkembangan janin serta kesehatan Ibu. Penelitian ini bertujuan untuk menganalisis faktor- faktor yang berhubungan dengan kejadian KEK pada Ibu hamil di wilayah pedesaan di Provinsi Riau, Indonesia. Studi potong lintang dilakukan dengan melibatkan 122 Ibu hamil yang berada pada trimester pertama dan kedua dari bulan Desember 2024 hingga Januari 2025. Probabilitas Proporsional Ukuran Sampling digunakan untuk memilih subjek penelitian yang berada pada 10 desa. Lingkar lengan atas (LiLa) diukur untuk menentukan kejadian KEK dengan kurang dari 23.5 cm sebagai indikator. Kuesioner terstruktur digunakan untuk mengumpulkan data sosio-demografis dan pantangan makanan. Kuesioner HFIAS digunakan untuk mengumpulkan data ketahanan pangan. Studi ini menemukan bahwa prevalensi KEK pada ibu hamil sebesar 35,2%. Pada analisis bivariat, status ekonomi, keberagaman pangan, paritas, pola konsumsi pangan, ketahanan pangan dan pantangan makanan memiliki hubungan yang signifikan dengan KEK. Setelah di kondisikan dengan beberapa variabelmenggunakan analisis logistik binari, paritas (AOR: 25.47; 95% CI:2.6-78.23), ketahanan pangan (AOR: 6.19; 95% CI: 2.05- 18.73), dan pantangan makanan (AOR: 6.44; 95%CI: 2.0- 20.648) menjadi faktor determinan KEK dengan Pvalue < 0.05. Persentase kejadian KEK pada ibu hamil di wilayah ini lebih tinggi jika dibandingkan dengan prevalensi nasional yang membutuhkan tindakan

segera. Intervensi yang menargetkan penyebab KEK, seperti paritas, ketahanan pangan, dan pantangan makanan sangat penting untuk mengurangi kejadian KEK.

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INTRODUCTION

The first one thousand days of life is a critical period that determines the next generation. If it is not utilized properly, it would cause permanent damages to the children (Setia et al., 2021). This period is started from conception until 2 years old children. Thus, maternal nutrition is required to be considered to produce a generation with optimal growth and development. However, pregnant women are prone to suffer malnutrition, particularly anaemia and chronic energy deficiency (CED). CED is a malnutrition where pregnant women had imbalance nutrition over prolonged period of time. If it occurs continuously it could inhibit the growth and development of the fetus as well as impair the immune system, causing the mother to be more susceptible to infections (K.Wati et al., 2024; Kuntari et al., 2024). Some studies also found that pregnant women with CED had higher risk to have a baby with low birth weight (Vasundhara et al., 2020; Yosefinata et al., 2022). Thus, immediate actions are required to mitigate severe outcomes in the future by addressing its risk factors.

CED can be measured using mid-upper circumference (MUAC) tape, that can be classified if the MUAC less than 23.5 cm. The measurement of maternal MUAC might assist in estimating the nutritional status of offspring that can facilitate the implementation of the measures taken to mitigate undernutrition, including risk of growth faltering and stunting in a family. Despite its feasibility, MUAC is commonly used at the national level to conduct a measurement of child and maternal nutritional status (Haque et al., 2021). According to the data from Health Survey Indonesia (SKI), the prevalence of CED among pregnant women is alarming. Even though, there was a decreasing prevalence from 17.3% in 2018 to 16.9% in 2023 (Indonesia Ministry of Health, 2018, 2023). This nutrition problem remains high. Riau is one of the provinces where most of the pregnant women experience CED, with the prevalence was above the national level (17.9%) (Indonesia Ministry of Health, 2023).

Food consumption pattern is one of the causes of CED that contributed to the lack of energy and protein intake. Individuals consumption pattern could be identified through examining their daily food intake (Puspitasari et al., 2023). Previous research indicated that Indonesia pregnant women had lower intake of both energy and protein. This was due to the existence of food taboos among pregnant women that hindered the consumption of these nutrient intake for a long time (Agustina et al., 2023). Food taboo referred to the condition that some foods were not allowed to be consumed due to several reasons such as cultural, health or individual beliefs (Angkasa et al., 2024). These foods included seafoods, starches and certain fruits and vegetables (Mogi et al., 2024).

Moreover, pregnant women from low socioeconomic family were more likely to experience food insecurity, which makes it more difficult for them to purchase nutritious food (K.Wati et

Commented [AM2]: To enhance the flow, consider adding a sentence or two connecting the broader issue of maternal malnutrition to the specific context of Riau Province before stating the study's aim. For example, "While maternal malnutrition is a concern across Indonesia, the situation in Riau Province presents unique challenges..." (followed by a citation if possible).

al., 2024). Most of households with food insecurity focused mainly quantity of foods consumed rather than quality, leading to alteration in dietary pattern (Ramadhani et al., 2021).
Considering the high prevalence of CED in Riau, there was a disparity regarding beliefs, attitudes, and behavior among pregnant women towards certain food consumptions. Therefore, this study aimed to examine all risk factors such as food taboo, dietary pattern, food diversity and food security with CED incidence among pregnant women in rural area of Bunga Raya district, Siak.

METHOD

Research Design

A cross sectional study was performed in Siak Regency, Riau Province, Indonesia. Data was collected on December 2024 to January 2025. Target population of this study was pregnant registered in Bunga Raya Health Centre, Siak. Inclusion criteria of the subjects were pregnant women in their first and second trimester who lived in Bunga Raya sub-district and possessing Mother Child Health (MCH) handbook

Population and Sample

The selection of sub-districts was done due to the highest prevalence of chronic energy deficiency (CED) among pregnant women. This study was conducted in 10 villages with a method probability proportional to size (PPS). There were 122 subjects participated in this study after calculated using Slovin formula.

Data Collection

CED data was obtained by measuring Mid-Upper Circumference (MUAC). It was classified as CED if the MUAC less than equal to 23,5 cm. Socio-demographic data such as education level, employment status, parity, and economic status were gathered using structured questionnaires. Dietary pattern was carried out using Food Frequency Questionnaire (FFQ) that had been validated through several process including food listing and focus group discussion among subjects with similar characteristics. The score was calculated using mean/median, depends on the data distribution. When the score was below the mean/median scores, it was classified as poor. Otherwise, when the score was above the mean/median, it was categorized as good dietary pattern. Food taboos were collected using standardized questionnaires developed by the researchers. Moreover, food diversity was obtained using 24-hour food recall which was classified as high diversity, if the subjects consumed more than 4 food groups and low diversity if the subjects consumed less than equal to 4 food groups. Food security was collected using Household Food Insecurity Access Scale (HFIAS). It was divided into 2 categories as food insecure and food secure household. Moreover, This study obtained ethical approval from Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta 5446/B.1/KEPK-FKUMS/XII/2024. All subjects agreed to be voluntarily participated and had signed an informed consent.

Commented [AM3]: •Specify the number of food items included in the FFQ.
•Briefly describe the focus group discussion (e.g., number of participants, key themes discussed).
•Explain how the mean/median was used to categorize dietary patterns (e.g., if it was a tertile split, etc.).

Data Analysis and Processing

Enumerators were recruited and selected based on their education background. Training was conducted among the enumerators regarding MUAC measurement and methods of interview by the researchers. Pre-test of questionnaire was tested on 5% of subjects outside the study area who had similar characteristics. During data collection, supervision was undertaken by the researchers. The data were coded and analyzed using software called SPSS version 20. Characteristic respondents were analyzed using descriptive statistics and displayed using tables. Logistic regression was employed to identify factors associated with CED by including

variables with p-value less than 0.25 in bivariate analysis. Adjusted odds ratio (AOR) was obtained using to indicate the strength of association with the corresponding 95% confidence interval (CI) using multiple logistic regression. At the end, variables with p-value less than 0.05 were considered as statistically significant.

RESULT

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting.(Abubakari et al., 2023; Ekowati et al., 2017) In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Table 1 presented that around 66.7% of pregnant women less than 20 years old were CED. Most of the CED subjects (87.5%) had 2 children who under 5 years old, followed by half of them were elementary school graduates. CED pregnant women who were in low-income family accounted for 70%. Regarding dietary diversity, it was profound that there was a significant relationship with CED incidence among pregnant women, in which 56.7% of them had less diverse diet. Twenty-eight (65.1%) of CED pregnant women were food insecure, almost 53.7% of them had poor dietary pattern and 66.7% were having food taboo.

Table 1 Characteristic of Subjects and Bivariate Analysis

Variables	CED	Non CED	Crude OR	P-value
	n (%)	n (%)		
Ages				
< 20 years old	6 (66.7)	3 (33.3)	2.80 (0.6-3.50)	0.096
20- 35 years old	35 (33.7)	69 (66.3)	1	
>35 years old	2 (22.2)	7 (77.8)	1.775 (0.35- 9.0)	
Parity				
< 3 times	17 (21.3)	63 (78.8)	1	0.000[a]
≥ 3 times	26 (61.9)	16 (38.1)	5.2 (3.6- 10.3)	
Education Level				
Not school	0 (0)	1 (100)		0.670
Elementary school	6 (50)	6 (50)	0.615(0.14-2.58)	
Senior High School	23 (31.5)	50 (68.5)	0.45 (0.2- 0.765)	
University	8 (38.1)	13 (61.9)	1	
Employment Status				
Housewives	37 (38.5)	67 (64.4)	1.1 (0.097- 5.32)	0.948
Civil Servants	5 (36.5)	8 (61.5)	0.92 (0.21- 4.07)	
Private Employee	1 (25)	3 (75)	1	
Economic Status				
Low income (Q1)	21 (70)	9 (30)	3.44 (1.84- 6.420)	0.000 [a]
Medium income (Q2)	16 (26.2)	45 (73.8)	1.45 (0.8- 3.50)	
High income (Q3)	6 (19.4)	25 (80.6)	1	
Dietary Diversity				
Less diverse (≤4 group)	17 (56.7)	13 (43.3)	3.32	0.009 [a]
More diverse (4 group)	26 (28.3)	66 (71.7)	(1.41- 7.79)	
Household Food Security				

Commented [AM4]: To enhance clarity for the reader, when presenting data from Table 1, consider adding a brief interpretation or implication of the finding within the text. For example, when stating "around 66.7% of pregnant women less than 20 years old were CED", add "This suggests that younger pregnant women are particularly vulnerable to CED in this area."

Food insecure	28 (65.1)	15 (34.9)	7.9 (3.43- 18.5)	0.000 [a]
Food secure	15 (19)	64 (81)		
Dietary Pattern				
Poor	29 (53.7)	25 (46.3)	4.47 (2.02- 9.91)	0.000 [a]
Good	14 (20.6)	54 (79.4)		
Food Taboo				
Yes	26 (66.7)	13 (33.3)	7.76 (3.3- 18.22)	0.000 [a]
No	17 (20.5)	66 (79.5)		

[a]Significant association (pvalue < 0.05) using chi-square

Table 2 indicated multivariate analysis using logistic regression with parity, household food security and food taboo were the determinant factors of CED. Pregnant women who had parity more than 3 were more likely to have higher risk to suffer CED (AOR: 25.47; 95% CI:2.60- 315.06). Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73).

Table 2 Multiple Regression of CED among Pregnant Women

Variables	B	S.E	Adjusted OR (95% CI)	Pvalue
Parity				
< 3 times			1	
≥ 3 times	3.238	1.283	25.47 (2.60- 315.06)	0.012
Household Food Security				
Food secure			1	
Food insecure	1.863	0.594	6.19 (2.05- 18.73)	0.001
Food Taboo				
No			1	
Yes	1.975	0.603	6.44 (2.0- 20.648)	0.002
Constant	-5.890	1.521	0.003	0.000

Analyzed using logistic regression; Pvalue <0.05; R^2 : 0.495; adjusted by economic status, education level and employment status

DISCUSSION

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. This study aligned with other study conducted by Angkasa et al (Angkasa et al., 2024) that there was a significant association between multiparous with CED among pregnant women. Having more than 2 times of pregnancy with close a birth distance would exacerbate the reproduction organs. While the mothers tried to recover herself by trying to consume adequate nutrient intake, conceiving again

Commented [AM5]: While the limitations are acknowledged [91,92], it would be beneficial to elaborate slightly on the potential implications of these limitations. For instance:
"The cross-sectional design limits our ability to establish causality; therefore, future longitudinal studies are needed to confirm the direction of the relationships observed."
"While 24-hour food recall can be subject to recall bias, we attempted to minimize this by [mentioning any techniques used, e.g., training enumerators thoroughly]."

lead the mothers became malnutrition (Puspitasari et al., 2023). Food insecurity and malnutrition among pregnant women which is worsened with gender discrimination contribute to an intergenerational cycle of nutritional problems (Benson & Shekar, 2006).

In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73). This result was consistent with other studies (Motbainor et al., 2017; Mukaddas et al., 2021; Ramadhani et al., 2021). Family income is related closely with the incidence of household food insecurity which was affected the power of purchasing on nutritious foods.(Puspitasari et al., 2023) This suggested that household food security is essential for the daily consumption of all household members since it might attribute to less diverse foods as well as inequality in food distribution among the household members causing them having poor dietary intake leading to undernutrition. (Gelebo et al., 2021; Motbainor et al., 2017)

Furthermore, food taboo was found to be a determinant factor of CED among pregnant women. It was found that 66.7% of CED pregnant women was reported to have a food restriction in their community. Eggs and shrimp were the most food items restricted by the pregnant women due to several reasons such as difficulties when delivering the babies and abscess to the newborn. This findings were consistent with numerous studies that some of animal proteins and certain foods were avoided by the pregnant women (Abere & Azene, 2023; Angkasa et al., 2024; Irwan & Nurcahyani, 2024). There might be some concerns that consumption of these foods might attach to the fetal skull which lead to a larger infant and the complication on labor (Tsegaye et al., 2021). Eggs and meats are food sources that are high in protein which is required by the pregnant women to enhance the weight of the fetus. And deficiency of protein in the long run will give an impact to the cause of malnutrition to the pregnant women.

The strength of this study was strong methodology by performing PPS in the sampling which could represent the situation in that area. However, cross-sectional demonstrated in this study has a limitation that could not determine the cause and effect relationship of the study. Also, 24-hour food recall used to measure dietary diversity might cause a bias.

CONCLUSION AND SUGGESTION

This study concludes that the incidence of CED was soaring and tended to be higher compared to national prevalence in Indonesia. Parity, economic status, dietary diversity, household food security, dietary pattern and food taboo were found to be associated with CED among pregnant women. In multivariate analysis, only several variables were found to be related to CED, such as parity, household food security and food taboo. Ensuring proper nutrition of pregnant women is pivotal to avoid severe outcomes of CED by empowering health workers. Health workers should encourage to educate pregnant women about healthy food consumption during the critical growth periods of life.

Commented [AM6]: To make the suggestions more actionable, consider framing them as specific recommendations for interventions or future research. For example:
- Instead of "Ensuring proper nutrition of pregnant women is pivotal...," write "We recommend that public health programs in the region prioritize interventions that improve the nutritional status of pregnant women..."
- Instead of "Health workers should encourage to educate pregnant women...," write "We recommend that health workers receive training on culturally sensitive nutrition counseling to address food taboos and promote healthy food consumption during pregnancy."

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CHRONIC ENERGY DEFICIENCY AND ITS ASSOCIATIED FACTORS AMONG PREGNANT WOMEN LIVING IN RURAL AREA, INDONESIA: A COMMUNITY BASED STUDY

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ABSTRACT

Chronic energy deficiency (CED) in Indonesia is highly prevalent among pregnant women leading to become a public health problem that require immediate actions due to the adverse effects in growth and development of the fetus as well as mothers' health. This study aimed to assess factors associated with CED among pregnant women in a particular rural area rural area, in Siak Regency which has high prevalence of CED. A cross sectional study was employed involving 122 pregnant women in first and second trimester from December 2024 to January 2025. Probability proportional to size (PPS) was used to select the subjects in 10 villages. Mid-Upper Arm Circumference (MUAC) was measured to determine CED incidence with less than 23.5 cm as a cut-off point. A structured questionnaire was used to collect socio-demographic, food security and food taboo. HFIAS questionnaire was performed to collect food security data. This study found that the prevalence of CED among pregnant women was 35.2%. In bivariate analysis, economic status, dietary diversity, parity, dietary pattern, food security and food taboo were found to have a significant association with CED. After adjusted by several variables using binary logistic, parity (AOR: 25.47; 95% CI:2.6- 78.23), food security (AOR: 6.19; 95% CI: 2.05- 18.73) and food taboo (AOR: 6.44; 95%CI: 2.0- 20.648) were exhibited to be determinant factors of CED with p value less than 0.05. The percentage of CED among pregnant women was higher compared to national prevalence which lead to urgent actions. Interventions targeting the causes of CED, such as parity, food security and food taboo are essential to reduce the CED incidence. This study results are expected to be a guidance for policy makers to create innovative intervention to reduce CED among pregnant women.

Kata Kunci:

Ibu Hamil; Kekurangan Energi Kronis; Pantangan Makanana; Ketahanan Pangan; Paritas

ABSTRAK

Kekurangan energi kronis (KEK) di Indonesia sangat umum terjadi pada Ibu hamil sehingga menjadi masalah kesehatan masyarakat yang memerlukan tindakan karena akan menimbulkan dampak yang buruk untuk pertumbuhan dan perkembangan janin serta kesehatan Ibu. Penelitian ini bertujuan untuk menganalisis faktor- faktor yang berhubungan dengan kejadian KEK pada Ibu hamil di wilayah pedesaan di Kabupaten Siak yang memiliki prevalensi KEK yang tinggi. Studi potong lintang dilakukan dengan melibatkan 122 Ibu hamil yang berada pada trimester pertama dan kedua dari bulan Desember 2024 hingga Januari 2025. Probabilitas Proporsional Ukuran Sampling digunakan untuk memilih subjek penelitian yang berada pada 10 desa. Lingkar lengan atas (LiLa) diukur untuk menentukan kejadian KEK dengan kurang dari 23.5 cm sebagai indikator. Kuesioner terstruktur digunakan untuk mengumpulkan data sosio-demografis dan pantangan makanan. Kuesioner HFIAS digunakan untuk mengumpulkan data ketahanan pangan. Studi ini menemukan bahwa prevalensi KEK pada ibu hamil sebesar 35,2%. Pada analisis bivariat, status ekonomi, keberagaman pangan, paritas, pola konsumsi pangan, ketahanan pangan dan pantangan makanan memiliki hubungan yang signifikan dengan KEK. Setelah di kondisikan dengan beberapa variabelmenggunakan analisis logistik binari, paritas (AOR: 25.47; 95% CI:2.6- 78.23), ketahanan pangan (AOR: 6.19; 95% CI: 2.05- 18.73), dan pantangan makanan (AOR: 6.44; 95%CI: 2.0- 20.648) menjadi

Commented [A1]: Please revisit this once the revision is taken.

Commented [AM2]: Briefly mention the specific characteristics of the "rural area in Riau Province" (e.g., primary economic activity, cultural context if relevant to food taboos) to provide context.

Commented [A3]: If there is space for more words, consider a statement on how these findings can guide public health strategies or policy.

faktor determinan KEK dengan Pvalue < 0.05. Persentase kejadian KEK pada ibu hamil di wilayah ini lebih tinggi jika dibandingkan dengan prevalensi nasional yang membutuhkan tindakan segera. Intervensi yang menargetkan penyebab KEK, seperti paritas, ketahanan pangan, dan pantangan makanan sangat penting untuk mengurangi kejadian KEK. Hasil penelitian ini diharapkan menjadi panduan bagi pembuat kebijakan untuk membuat intervensi yang inovatif untuk mengurangi angka KEK pada Ibu hamil.

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INTRODUCTION

The first one thousand days of life is a critical period that determines the next generation. If this stage is not taken seriously, it would cause per damages to the children as it is considered as a golden period of life (Setia et al., 2021). This period is started from conception until 2 years old children. However, pregnant women are prone to suffer malnutrition, particularly anaemia and chronic energy deficiency (CED). CED is a form of malnutrition characterized by prolonged inadequate energy intake leading to nutritional imbalance pregnant women. If it occurs continuously it could inhibit the growth and development of the fetus as well as impair the immune system, causing the mother to be more susceptible to infections (K.Wati et al., 2024; Kuntari et al., 2024). Some studies also found that pregnant women with CED had higher risk to have a baby with low birth weight (Vasundhara et al., 2020; Yosefinata et al., 2022). Thus, immediate actions are required to mitigate severe outcomes in the future by addressing its risk factors.

CED can be measured using mid-upper circumference (MUAC) tape, that can be classified if the MUAC less than 23.5 cm. The measurement of maternal MUAC might assist in estimating the nutritional status of offspring that can facilitate the implementation of the measures taken to mitigate undernutrition, including risk of growth faltering and stunting in a family. Despite its feasibility, MUAC is commonly used at the national level to conduct a measurement of child and maternal nutritional status (Haque et al., 2021). According to the data from Health Survey Indonesia (SKI), the prevalence of CED among pregnant women is alarming. Even though, there was a decreasing prevalence from 17.3% in 2018 to 16.9% in 2023 (Indonesia Ministry of Health, 2018, 2023). This nutrition problem remains high. Riau is one of the provinces where most of the pregnant women experience CED, with the prevalence was above the national level (17.9%) (Indonesia Ministry of Health, 2023).

CED is directly caused by inadequate intake of energy and protein for a long time as a result of having poor food consumption pattern. Individuals consumption pattern could be identified through examining their daily food intake (Puspitasari et al., 2023). Previous research indicated that Indonesia pregnant women had lower intake of both energy and protein. This was due to the existence of food taboos among pregnant women that hindered the consumption of these nutrient intake for a long time (Agustina et al., 2023). Food taboo referred to the condition that some foods were not allowed to be consumed due to several reasons such as cultural, health or individual beliefs (Angkasa et al., 2024). These foods included seafoods, starches and certain fruits and vegetables (Mogi et al., 2024).

Moreover, pregnant women from low socioeconomic family were more likely to experience food insecurity, which makes it more difficult for them to purchase nutritious food (K.Wati et

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Commented [A5]: This sentence does not make of any senses.

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For example, the phrase "CED is a malnutrition where pregnant women had imbalance nutrition over prolonged period of time" could be better stated as "CED is a form of malnutrition characterized by prolonged inadequate energy intake leading to nutritional imbalance in pregnant women."

Commented [A7]: This can cause a misunderstanding that food patterns can cause CED. Please rephrase.

Commented [A8]: Which studies? What were the results? Could it be represented general Indonesian population?

al., 2024). Most of households with food insecurity focused mainly quantity of foods consumed rather than quality, leading to alteration in dietary pattern (Ramadhani et al., 2021).
Considering the high prevalence of CED in Riau, there is a lack of research assessing factors associated of CED in this area while the number of CED among pregnant women is alarming. To address this knowledge gap, this study aimed to examine all risk factors such as food taboo, dietary pattern, food diversity and food security with CED incidence among pregnant women in rural area of Bunga Raya district, Siak. The study is expected to help governments and policy makers to design intervention targeting pregnant women with CED in rural area of Riau Province.

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After describing the research gap, give the problem statement, followed by the research aim at the end of this paragraph. In this way, readers will understand the urgency of this paper and what to expect in the following sections.

METHOD

Research Design

A cross sectional study was performed in Siak Regency, Riau Province, Indonesia. Data was collected on December 2024 to January 2025. Target population of this study was pregnant registered in Bunga Raya Health Centre, Siak. Inclusion criteria of the subjects were pregnant women in their first and second trimester who lived in Bunga Raya sub-district and possessing Mother Child Health (MCH) handbook

Population and Sample

The selection of sub-districts was done due to the highest prevalence of chronic energy deficiency (CED) among pregnant women. This study was conducted using probability proportional to size (PPS) method. PPS is a method where the subjects have similar chance to be selected. Bunga Raya Health Center consisted of 10 villages. The number of pregnant women from each village participated in this study was based on the proportion pregnant women in each villages. There were 122 subjects who participated in this study after being calculated using the Slovin formula. Random sampling was employed to select the subjects from each village.

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Data Collection

CED data was obtained by measuring Mid-Upper Circumference (MUAC) using MUAC tape. It was classified as CED if the MUAC less than equal to 23,5 cm. Socio-demographic data such as education level, employment status, parity, and economic status were gathered using structured questionnaires. Dietary pattern was carried out using Food Frequency Questionnaire (FFQ) that had been validated through several process including food listing and focus group discussion among subjects with similar characteristics. Number of people participated in this FGD was 10 to discuss about food commonly consumed in the last 3 months. Total 99 food groups were obtained to be asked to the subjects. The score was calculated using median since the data was not normally distributed using Kolmogorov Smirnov. When the score was below the mean/median scores, it was classified as poor. Otherwise, when the score was above the mean/median, it was categorized as good dietary pattern.

Food taboos information was collected using standardized questionnaires developed by the researchers. Subjects were asked about availability of food restrictions during pregnancy and the reasons to not consume its related foods. Moreover, food diversity was obtained using Individual Dietary Diversity Score (IDDS), which comprises 9 food groups, including staple foods, dark green leafy vegetables, other fruits and vegetables, meat and fish, eggs, legumes, nuts, seeds, milk and milk products. The information was obtained using 2x24-hour food recall. When the subjects consumed certain food groups more than 10 grams, it was assigned as 1. Through IDDS form, if the food groups consumed less than 4 groups, it was classified as less diverse.

Food security was collected using standardized questionnaire called Household Food Insecurity Access Scale (HFIAS) which was developed by Food and Nutrition Technical Assistant Project (Coates et al., 2007). The subjects were asked about household condition for the past four weeks. The score generated from this questionnaire was 0 to 27. This study classified into 2 categories as food insecure and food secure household.

In addition, This study obtained ethical approval from Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta 5446/B.1/KEPK-FKUMS/XII/2024. All subjects agreed to be voluntarily participated and had signed an informed consent.

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Additionally, some grammatical errors were identified in this paragraph. Suggest revision.

Commented [A12]: Was this relevant to this study?

Data Analysis and Processing

Enumerators were recruited and selected based on their education background. Training was conducted among the enumerators regarding MUAC measurement and methods of interview by the researchers. Pre-test of questionnaire was tested on 5% of subjects outside the study area who had similar characteristics. During data collection, supervision was undertaken by the researchers. The data were coded and analyzed using software called SPSS version 20. Characteristic respondents were analyzed using descriptive statistics and displayed using tables. Logistic regression was employed to identify factors associated with CED by including variables with p-value less than 0.25 in bivariate analysis. Adjusted odds ratio (AOR) was obtained using to indicate the strength of association with the corresponding 95% confidence interval (CI) using multiple logistic regression. At the end, variables with p-value less than 0.05 were considered as statistically significant.

RESULT

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting.(Abubakari et al., 2023; Ekowati et al., 2017) In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to be significantly associated which is analyzed using multivariate analysis with P-value < 0.05, including parity, socioeconomic status, household food security and food taboo.

Table 1 presented that around 66.7% of pregnant women less than 20 years old were CED. This suggest that younger pregnant women are particularly vulnerable to CED in this area. Most of the CED subjects (87.5%) had 2 children who under 5 years old, followed by half of them were elementary school graduates. This condition lead to lack of knowledge regarding nutrition which bring about CED among them. CED pregnant women who were in low-income family accounted for 70%. Regarding dietary diversity, it was profound that there was a significant relationship with CED incidence among pregnant women, in which 56.7% of them had less diverse diet. Twenty-eight (65.1%) of CED pregnant women were food insecure, almost 53.7% of them had poor dietary pattern and 66.7% were having food taboo.

Table 1 Characteristic of Subjects and Bivariate Analysis

Commented [A13]: How are these variables categorised? There was no explanation in the method section.

Variables	CED	Non CED	Crude OR	P-value
	n (%)	n (%)		
Ages				
< 20 years old	6 (66.7)	3 (33.3)	2.80 (0.6-3.50)	0.096
20- 35 years old	35 (33.7)	69 (66.3)	1	
>35 years old	2 (22.2)	7 (77.8)	1.775 (0.35- 9.0)	

Parity				
< 3 times	17 (21.3)	63 (78.8)	1	0.000[a]
≥ 3 times	26 (61.9)	16 (38.1)	5.2 (3.6- 10.3)	
Education Level				
Not school	0 (0)	1 (100)		0.670
Elementary school	6 (50)	6 (50)	0.615(0.14-2.58)	
Senior High School	23 (31.5)	50 (68.5)	0.45 (0.2- 0.765)	
University	8 (38.1)	13 (61.9)	1	
Employment Status				
Housewives	37 (38.5)	67 (64.4)	1.1 (0.097- 5.32)	0.948
Civil Servants	5 (36.5)	8 (61.5)	0.92 (0.21- 4.07)	
Private Employee	1 (25)	3 (75)	1	
Economic Status				
Low income (Q1)	21 (70)	9 (30)	3.44 (1.84- 6.420)	0.000 [a]
Medium income (Q2)	16 (26.2)	45 (73.8)	1.45 (0.8- 3.50)	
High income (Q3)	6 (19.4)	25 (80.6)	1	
Dietary Diversity				
Less diverse (≤4 group)	17 (56.7)	13 (43.3)	3.32	0.009 [a]
More diverse (4 group)	26 (28.3)	66 (71.7)	(1.41- 7.79)	
Household Food Security				
Food insecure	28 (65.1)	15 (34.9)	7.9 (3.43- 18.5)	0.000 [a]
Food secure	15 (19)	64 (81)		
Dietary Pattern				
Poor	29 (53.7)	25 (46.3)	4.47 (2.02- 9.91)	0.000 [a]
Good	14 (20.6)	54 (79.4)		
Food Taboo				
Yes	26 (66.7)	13 (33.3)	7.76 (3.3- 18.22)	0.000 [a]
No	17 (20.5)	66 (79.5)		

[a]Significant association (pvalue < 0.05) using chi-square

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Table 2 indicated multivariate analysis using logistic regression with parity, household food security and food taboo were the determinant factors of CED. Pregnant women who had parity more than 3 were more likely to have higher risk to suffer CED (AOR: 25.47; 95% CI:2.60- 315.06). Parity was found to be associated with CED with adjusted OR 25.47 (2.60-315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73).

Table 2 Multiple Regression of CED among Pregnant Women

Variables	B	S.E	Adjusted OR (95% CI)	Pvalue
Parity				
< 3 times			1	
≥ 3 times	3.238	1.283	25.47 (2.60- 315.06)	0.012
Household Food Security				
Food secure			1	
Food insecure	1.863	0.594	6.19 (2.05- 18.73)	0.001
Food Taboo				
No			1	
Yes	1.975	0.603	6.44 (2.0- 20.648)	0.002

Commented [A15]: Extremely wide confidence interval for parity (2.60–315.06) should be acknowledged, as it might indicate limited precision or sample size issues. Commenting on this in the discussion would demonstrate critical appraisal of the results.

Constant	-5.890	1.521	0.003	0.000

Analyzed using logistic regression; Pvalue <0.05; R^2 : 0.495; adjusted by economic status, age, education level and employment status

DISCUSSION

This study aimed to assess the prevalence and its associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition that is mostly experienced by low-income family. CED could lead to severe birth outcomes such as low birth weight baby, mortality and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers were found approximately 35.2% which was more likely higher compared to Indonesia prevalence. Furthermore, several predictors were found to identified as significant predictors through multivariate analysis ($p < 0.05$), including parity, socioeconomic status, household food security and food taboo.

Parity was found to be associated with CED with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had higher risk of CED. This study aligned with other study conducted by Angkasa et al (Angkasa et al., 2024) that there was a significant association between multiparous with CED among pregnant women. Having more than 2 times of pregnancy with close a birth distance would exacerbate the reproduction organs. While the mothers tried to recover herself by trying to consume adequate nutrient intake, conceiving again lead the mothers became malnutrition (Puspitasari et al., 2023). Short birth interval could cause mother's nutrition depleted that will lead to the higher risk of growth retardation and infants' nutrient storage as well as nutrient delivery through breast.

When a new pregnancy occurred, the current child experienced weaning or reduction on having breastmilk that made her be vulnerable to infection and inadequate intake. However, the association between short birth interval and breastfeeding was reversible. The termination of breastfeeding cause mothers became fertile, resulting in another pregnancy (Dewey & Cohen, 2007). However, the current finding indicated a large gap of confidence interval due to small sample size. Thus, increasing the sample size is required to minimize the interval.

In addition, household food security showed a significant association with CED among pregnant women with food insecure household had 6.19 higher risk to suffer CED (AOR: 6.19, 95% CI: 2.05- 18.73). Food insecurity and malnutrition among pregnant women which is worsened with gender discrimination contribute to an intergenerational cycle of nutritional problems (Benson & Shekar, 2006). This result was consistent with other studies (Motbainor et al., 2017; Mukaddas et al., 2021; Ramadhani et al., 2021). Family income is related closely with the incidence of household food insecurity which was affected the power of purchasing on nutritious foods.(Puspitasari et al., 2023) This suggested that household food security is essential for the daily consumption of all household members since it might attribute to less diverse foods as well as inequality in food distribution among the household members causing them having poor dietary intake leading to undernutrition. (Gelebo et al., 2021; Motbainor et al., 2017)

Furthermore, food taboo was found to be a determinant factor of CED among pregnant women. It was found that 66.7% of CED pregnant women was reported to have a food restriction in their community. People living in rural area have strong beliefs on food consumption particularly among pregnant and lactating mothers that will affect their behavior. This will be passed to the next generation that will contribute to the lack consumption of certain foods (Nurbaya et al., 2024). Eggs and shrimp were the most food items restricted by the pregnant women due to several reasons such as difficulties when delivering the babies and abscess to the newborn. This findings were consistent with numerous studies that some of animal proteins and certain foods were avoided by the pregnant women (Abere & Azene, 2023; Angkasa et al., 2024; Nurbaya et al., 2024). There might be some concerns that consumption

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"The cross-sectional design limits our ability to establish causality; therefore, future longitudinal studies are needed to confirm the direction of the relationships observed."
"While 24-hour food recall can be subject to recall bias, we attempted to minimize this by [mentioning any techniques used, e.g., training enumerators thoroughly]."

Commented [A17]: This could be rephrased to "identified as significant predictors through multivariate analysis ($p < 0.05$).

Commented [A18]: The explanation in this paragraph is not deep and could potentially be enhanced.

Consider giving a deeper explanation of the biological and social mechanisms underlying parity-CED relationships. For example, how high parity and short birth intervals biologically and nutritionally contribute to maternal depletion would strengthen the interpretation.

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Commented [A20]: Again, please elaborate further. Why is this consistent? Why not? What are the implications? Explain them in more detail.

of these foods might attach to the fetal skull which lead to a larger infant and the complication on labor (Tsegaye et al., 2021). Eggs and meats are food sources that are high in protein which is required by the pregnant women to enhance the weight of the fetus. And deficiency of protein in the long run will give an impact to the cause of malnutrition to the pregnant women.

The strength of this study was strong methodology by performing PPS in the sampling which could represent the situation in that area. However, cross-sectional demonstrated in this study limits our ability to establish causality; therefore, future longitudinal studies are needed to confirm the direction of the relationships observed. While 24-hour food recall can be subject to recall bias, we attempted to minimize this by training enumerators thoroughly.

Commented [A21]: This is a limitation of the study design, but not of your study. Study limitations should be some aspect that can probably impact the reliability and generalizability of the findings. Please revise it.

CONCLUSION AND SUGGESTION

This study concludes that the incidence of CED was soaring and tended to be higher compared to national prevalence in Indonesia. Parity, economic status, dietary diversity, household food security, dietary pattern and food taboo were found to be associated with CED among pregnant women. In multivariate analysis, the variables are adjusted with possible confounding factors, such as income, employment status, age and education level. However, only several variables were found to be related to CED, such as parity, household food security and food taboo. Ensuring proper nutrition of pregnant women is pivotal to avoid severe outcomes of CED by empowering health workers. Health workers should encourage to educate pregnant women about healthy food consumption during the critical growth periods of life.

Commented [A22]: The distinction between bivariate and multivariate findings should be clearly emphasised. For example, specify that while multiple factors were associated in initial analyses, only parity, household food security, and food taboo remained significant in the multivariate model.

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CHRONIC ENERGY DEFICIENCY AND ITS ASSOCIATED FACTORS AMONG PREGNANT WOMEN LIVING IN RURAL AREAS, INDONESIA: A COMMUNITY BASED STUDY

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ABSTRACT

Chronic energy deficiency (CED) in Indonesia is highly prevalent among pregnant women, becoming a public health problem that requires immediate action due to the adverse effects on the growth and development of the fetus as well as the health of the mother. This study aims to assess factors associated with CED among pregnant women in a particular rural area, in Siak Regency, which has a high prevalence of CED. A cross-sectional study was employed involving 122 pregnant women in the first and second trimesters from December 2024 to January 2025. Probability proportional to size (PPS) was used to select the subjects in 10 villages. Mid-Upper Arm Circumference (MUAC) was measured to determine CED incidence with less than 23.5 cm as a cut-off point. A structured questionnaire was used to collect socio-demographic, food security, and food taboo data. The HFIAS questionnaire was used to collect food security data. This study has found that the prevalence of CED among pregnant women is 35.2%. In bivariate analysis, economic status, dietary diversity, parity, dietary pattern, food security, and food taboo have a significant association with CED. After adjusted by several variables using binary logistic, parity (AOR: 25.47; 95% CI:2.6- 78.23), food security (AOR: 6.19; 95% CI: 2.05- 18.73) and food taboo (AOR: 6.44; 95%CI: 2.0- 20.648) are exhibited to be determinant factors of CED with p-value less than 0.05. The percentage of CED among pregnant women is higher compared to the national prevalence, which leads to urgent actions. Interventions targeting the causes of CED, such as parity, food security, and food taboo, are essential to reduce the incidence of CED. The results of this study are expected to guide policymakers in creating innovative interventions to reduce CED among pregnant women.

Kata Kunci:
Ibu Hamil;
Kekurangan Energi Kronis;
Pantangan Makanan;
Ketahanan Pangan;
Paritas.

ABSTRAK

Kekurangan energi kronis (KEK) di Indonesia sangat umum terjadi pada Ibu hamil sehingga menjadi masalah kesehatan masyarakat yang memerlukan tindakan karena akan menimbulkan dampak yang buruk untuk pertumbuhan dan perkembangan janin serta kesehatan Ibu. Penelitian ini bertujuan untuk menganalisis faktor- faktor yang berhubungan dengan kejadian KEK pada Ibu hamil di wilayah pedesaan di Kabupaten Siak yang memiliki prevalensi KEK yang tinggi. Studi potong lintang dilakukan dengan melibatkan 122 Ibu hamil yang berada pada trimester pertama dan kedua dari bulan Desember 2024 hingga Januari 2025. Probabilitas Proporsional Ukuran Sampling digunakan untuk memilih subjek penelitian yang berada pada 10 desa. Lingkar lengan atas (LiLa) diukur untuk menentukan kejadian KEK dengan kurang dari 23.5 cm sebagai indikator. Kuesioner terstruktur digunakan untuk mengumpulkan data sosio-demografis dan pantangan makanan. Kuesioner HFIAS digunakan untuk mengumpulkan data ketahanan pangan. Studi ini menemukan bahwa prevalensi KEK pada ibu hamil sebesar 35,2%. Pada analisis bivariat, status ekonomi, keberagaman pangan, paritas, pola konsumsi pangan, ketahanan pangan dan pantangan makanan memiliki hubungan yang signifikan dengan KEK. Setelah di kondisikan dengan beberapa variabelmenggunakan analisis logistik binari, paritas (AOR: 25.47; 95% CI:2.6- 78.23), ketahanan pangan (AOR: 6.19; 95% CI: 2.05- 18.73), dan pantangan makanan (AOR: 6.44; 95%CI: 2.0- 20.648) menjadi faktor determinan KEK dengan Pvalue < 0.05. Persentase kejadian KEK pada ibu hamil di wilayah ini lebih tinggi jika dibandingkan dengan prevalensi nasional yang membutuhkan tindakan segera. Intervensi yang menargetkan penyebab KEK, seperti paritas, ketahanan pangan, dan pantangan makanan sangat penting untuk mengurangi kejadian KEK. Hasil penelitian ini diharapkan menjadi panduan bagi pembuat kebijakan untuk membuat intervensi yang inovatif untuk mengurangi angka KEK pada Ibu hamil.

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INTRODUCTION

The first thousand days of life are a critical period that determines the next generation. If this stage is not taken seriously, it would cause irreparable damage to the children, as it is considered a golden period of life (Setia et al., 2021). This period starts from conception until 2 years old. However, pregnant women are prone to suffer malnutrition, particularly anaemia and chronic energy deficiency (CED). CED is a form of malnutrition characterized by prolonged inadequate energy intake leading to nutritional imbalance in pregnant women. If it occurs continuously, it could inhibit the growth and development of the fetus as well as impair the immune system, causing the mother to be more susceptible to infections (K.Wati et al., 2024; Kuntari et al., 2024). Some studies also found that pregnant women with CED had a higher risk of having a baby with low birth weight (Vasundhara et al., 2020; Yosefinata et al., 2022). Thus, immediate actions are required to mitigate severe outcomes in the future by addressing the risk factors.

CED can be measured using mid-upper arm circumference (MUAC) tape, which can be classified if the MUAC is less than 23.5 cm. The measurement of maternal MUAC might assist in estimating the nutritional status of offspring, which can facilitate the implementation of the measures taken to mitigate undernutrition, including the risk of growth faltering and stunting in a family. Despite its feasibility, MUAC is commonly used at the national level to conduct a measurement of child and maternal nutritional status (Haque et al., 2021). According to the data from the Health Survey Indonesia (SKI), the prevalence of CED among pregnant women is alarming. Even though there was a decrease in prevalence from 17.3% in 2018 to 16.9% in 2023 (Indonesia Ministry of Health, 2018, 2023). This nutritional problem remains high. Riau is one of the provinces where most of the pregnant women experience CED, with the prevalence being above the national level (17.9%) (Indonesia Ministry of Health, 2023).

CED is directly caused by inadequate intake of energy and protein for a long time as a result of having a poor food consumption pattern. Individuals' consumption patterns could be identified through examining their daily food intake (Puspitasari et al., 2023). Previous research indicated that pregnant women in Indonesia had lower intake of both energy and protein. This was due to the existence of food taboos among pregnant women that hindered the consumption of these nutrients for a long time (Agustina et al., 2023). Food taboo refers to the condition that some foods are not allowed to be consumed due to several reasons, such as cultural, health, or individual beliefs (Angkasa et al., 2024). These foods included seafoods, starches, and certain fruits and vegetables (Mogi et al., 2024).

Moreover, pregnant women from low socioeconomic families were more likely to experience food insecurity, which makes it more difficult for them to purchase nutritious food (K.Wati et al., 2024). Most households with food insecurity focus mainly on the quantity of food consumed rather than quality, leading to an alteration in dietary patterns (Ramadhani et al., 2021). Considering the high prevalence of CED in Riau, there is a lack of research assessing factors associated with CED in this area, while the number of CED among pregnant women is alarming. To address this knowledge gap, this study aimed to examine all risk factors, such as food taboo, dietary pattern, food diversity, and food security, with CED incidence among pregnant women in a rural area of Bunga Raya district, Siak. The study is expected to help governments and policymakers design interventions targeting pregnant women with CED in rural areas of Riau Province.

METHOD

Type of Research

A cross-sectional study was performed in Siak Regency, Riau Province, Indonesia. Data was collected from December 2024 to January 2025. The target population of this study was pregnant women registered in Bunga Raya Health Centre, Siak. Inclusion criteria of the subjects were pregnant women in their first and second trimesters who lived in the Bunga Raya sub-district and possessed the Mother Child Health (MCH) handbook.

Population and Sample

The selection of sub-districts was done due to the highest prevalence of chronic energy deficiency (CED) among pregnant women. This study was conducted using the probability proportional to size (PPS) method. PPS is a method where the subjects have an equal chance to be selected. Bunga Raya Health Center consisted of 10 villages. The number of pregnant women from each village who participated in this study was based on the proportion of pregnant women in each village. One hundred twenty-two subjects

participated in this study after being calculated using the Slovin formula. Random sampling was employed to select the subjects from each village.

Data Collection

CED data was obtained by measuring Mid-Upper Circumference (MUAC) using MUAC tape. It was classified as CED if the MUAC was less than or equal to 23,5 cm. Socio-demographic data such as education level, employment status, parity, and economic status were gathered using structured questionnaires. Dietary patterns were carried out using the Food Frequency Questionnaire (FFQ), which had been validated through several processes, including food listing and focus group discussion among subjects with similar characteristics. A number of people who participated in this FGD were 10, to discuss food commonly consumed in the last 3 months. A total of 99 food groups were obtained to be asked of the subjects. The score was calculated using the median since the data was not normally distributed, using Kolmogorov-Smirnov. When the score was below the mean/median scores, it was classified as poor. Otherwise, when the score was above the mean/median, it was categorized as a good dietary pattern.

Food taboos information was collected using standardized questionnaires developed by the researchers. Subjects were asked about the availability of food restrictions during pregnancy and the reasons for not consuming related foods. Moreover, food diversity was obtained using the Individual Dietary Diversity Score (IDDS), which comprises nine food groups, including staple foods, dark green leafy vegetables, other fruits and vegetables, meat and fish, eggs, legumes, nuts, seeds, milk, and milk products. The information was obtained using a 2x24-hour food recall. When the subjects consumed certain food groups in amounts greater than 10 grams, it was assigned as 1. Through the IDDS form, if the food groups consumed were fewer than 4 groups, it was classified as less diverse.

Food security was collected using a standardized questionnaire called the Household Food Insecurity Access Scale (HFIAS), which was developed by the Food and Nutrition Technical Assistance Project (Coates et al., 2007). The subjects were asked about household conditions for the past four weeks. The score generated from this questionnaire was 0 to 27. This study was classified into two categories: food-insecure and food-secure households. In addition, this study obtained ethical approval from the Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta 5446/B.1/KEPK-FKUMS/XII/2024. All subjects agreed to participate voluntarily and signed an informed consent form.

Data Analysis and Processing

Enumerators were recruited and selected based on their educational background. Training was conducted among the enumerators regarding MUAC measurement and methods of interview by the researchers. A pre-test of the questionnaire was conducted on 5% of subjects outside the study area who had similar characteristics. During data collection, the researchers undertook supervision. The data were coded and analyzed using software called SPSS version 20. Characteristic respondents were analyzed using descriptive statistics and displayed using tables. Logistic regression was employed to identify factors associated with CED by including variables with a p-value less than 0.25 in bivariate analysis. Adjusted odds ratio (AOR) was obtained to indicate the strength of association with the corresponding 95% confidence interval (CI) using multiple logistic regression. In the end, variables with a p-value of less than 0.05 were considered statistically significant.

RESULT

This study aimed to assess the prevalence and associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition, which is mostly experienced by low-income families. CED could lead to severe birth outcomes such as low birth weight babies, mortality, and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers was found to be approximately 35.2%, which was more likely higher compared to the Indonesia prevalence. Furthermore, several predictors were found to be significantly associated, which were analyzed using multivariate analysis with a P-value < 0.05, including parity, socioeconomic status, household food security, and food taboo.

Table 1 presents that around 66.7% of pregnant women less than 20 years old were CED. This suggests that younger pregnant women are particularly vulnerable to CED in this area. Most of the CED subjects (87.5%) had two children who were under 5 years old, and half of them were elementary school

graduates. This condition leads to a lack of knowledge regarding nutrition, which brings about CED among them. CED pregnant women who were in low-income families accounted for 70%. Regarding dietary diversity, it was profound that there was a significant relationship with CED incidence among pregnant women, in which 56.7% of them had a less diverse diet. Twenty-eight (65.1%) of CED pregnant women were food insecure, almost 53.7% of them had a poor dietary pattern, and 66.7% had food taboos.

Table 1. Characteristic of Subjects and Bivariate Analysis

Variables	CED	Non CED	Crude OR	P-value
	n (%)	n (%)		
Ages				
< 20 years old	6 (66.7)	3 (33.3)	2.80 (0.6-3.50)	0.096
20- 35 years old	35 (33.7)	69 (66.3)	1	
>35 years old	2 (22.2)	7 (77.8)	1.775 (0.35- 9.0)	
Parity				
< 3 times	17 (21.3)	63 (78.8)	1	0.000[a]
≥ 3 times	26 (61.9)	16 (38.1)	5.2 (3.6- 10.3)	
Education Level				
Not school	0 (0)	1 (100)		0.670
Elementary school	6 (50)	6 (50)	0.615(0.14-2.58)	
Senior High School	23 (31.5)	50 (68.5)	0.45 (0.2- 0.765)	
University	8 (38.1)	13 (61.9)	1	
Employment Status				
Housewives	37 (38.5)	67 (64.4)	1.1 (0.097- 5.32)	0.948
Civil Servants	5 (36.5)	8 (61.5)	0.92 (0.21- 4.07)	
Private Employee	1 (25)	3 (75)	1	
Economic Status				
Low income (Q1)	21 (70)	9 (30)	3.44 (1.84- 6.420)	0.000 [a]
Medium income (Q2)	16 (26.2)	45 (73.8)	1.45 (0.8- 3.50)	
High income (Q3)	6 (19.4)	25 (80.6)	1	
Dietary Diversity				
Less diverse (≤4 groups)	17 (56.7)	13 (43.3)	3.32	0.009 [a]
More diverse (4 groups)	26 (28.3)	66 (71.7)	(1.41- 7.79)	
Household Food Security				
Food insecure	28 (65.1)	15 (34.9)	7.9 (3.43- 18.5)	0.000 [a]
Food secure	15 (19)	64 (81)		
Dietary Pattern				
Poor	29 (53.7)	25 (46.3)	4.47 (2.02- 9.91)	0.000 [a]
Good	14 (20.6)	54 (79.4)		
Food Taboo				
Yes	26 (66.7)	13 (33.3)	7.76 (3.3- 18.22)	0.000 [a]
No	17 (20.5)	66 (79.5)		

[a] significant association (p-value < 0.05) using chi-square

Table 2 indicates multivariate analysis using logistic regression, with parity, household food security, and food taboo being the determinant factors of CED. Pregnant women who had parity more than 3 were more likely to have a higher risk of suffering CED (AOR: 25.47; 95% CI: 2.60- 315.06). Parity was associated with CED, with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had a higher risk of CED. In addition, household food security showed a significant association with CED among pregnant women; those with food-insecure households had a 6.19 times higher risk of suffering CED (AOR: 6.19, 95% CI: 2.05- 18.73).

Table 2. Multiple Regression of CED among Pregnant Women

Variables	B	S.E	Adjusted OR (95% CI)	P-value
Parity				
< 3 times			1	
≥ 3 times	3.238	1.283	25.47 (2.60- 315.06)	0.012
Household Food Security				
Food secure			1	
Food insecure	1.863	0.594	6.19 (2.05- 18.73)	0.001
Food Taboo				
No			1	
Yes	1.975	0.603	6.44 (2.0- 20.648)	0.002
Constant	-5.890	1.521	0.003	0.000

Analyzed using logistic regression; P-value <0.05; R^2: 0.495; adjusted by economic status, age, education level, and employment status.

DISCUSSION

This study aimed to assess the prevalence and associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition, which is mostly experienced by low-income families. CED could lead to severe birth outcomes such as low birth weight babies, mortality, and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers was found to be approximately 35.2%, which was more likely higher compared to the Indonesia prevalence. Furthermore, several predictors were identified as significant through multivariate analysis ($p < 0.05$), including parity, socioeconomic status, household food security, and food taboo.

Parity was associated with CED, with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had a higher risk of CED. This study aligned with another study conducted by Angkasa et al (Angkasa et al., 2024) that there was a significant association between multiparous women and CED among pregnant women. Having more than 2 pregnancies with close birth intervals would exacerbate the reproductive organs. While the mothers tried to recover by trying to consume adequate nutrient intake, conceiving again led the mothers to become malnutrition (Puspitasari et al., 2023). Short birth interval could cause mother's nutrition depleted that will lead to the higher risk of growth retardation and infants' nutrient storage as well as nutrient delivery through breast.

When a new pregnancy occurred, the current child experienced weaning or reduction in having breastmilk, which made her vulnerable to infection and inadequate intake. However, the association between short birth intervals and breastfeeding was reversible. The termination of breastfeeding causes mothers to become fertile, resulting in another pregnancy (Dewey & Cohen, 2007). However, the current finding indicated a large gap in the confidence interval due to the small sample size. Thus, increasing the sample size is required to minimize the interval.

In addition, household food security showed a significant association with CED among pregnant women; those with food-insecure households had a 6.19 times higher risk of suffering CED (AOR: 6.19, 95% CI: 2.05- 18.73). Food insecurity and malnutrition among pregnant women, which is worsened by gender discrimination, contribute to an intergenerational cycle of nutritional problems (Benson & Shekar, 2006). This result was consistent with other studies (Motbainor et al., 2017; Mukaddas et al., 2021; Ramadhani et al., 2021). Family income is closely related to the incidence of household food insecurity, which affects the purchasing power for nutritious foods (Puspitasari et al., 2023). This suggests that household food security is essential for the daily consumption of all household members since it might contribute to less diverse foods as well as inequality in food distribution among the household members, causing them to have poor dietary intake, leading to undernutrition (Gelebo et al., 2021; Motbainor et al., 2017).

Furthermore, food taboo was found to be a determinant factor of CED among pregnant women. It was found that 66.7% of CED pregnant women were reported to have a food restriction in their community. People living in rural areas have strong beliefs about food consumption, particularly among pregnant and lactating mothers, which will affect their behavior. This will be passed to the next generation, which will contribute to the lack of consumption of certain foods (Nurbaya et al., 2024). Eggs and shrimp were the most restricted food items by pregnant women due to several reasons, such as difficulties when delivering

the babies and abscesses in newborns. These findings were consistent with numerous studies that some animal proteins and certain foods were avoided by pregnant women (Abere & Azene, 2023; Angkasa et al., 2024; Nurbaya et al., 2024). There might be some concerns that consumption of these foods might be associated with the fetal skull, which leads to a larger infant and complications during labor (Tsegaye et al., 2021). Eggs and meat are food sources high in protein required by pregnant women to enhance the weight of the fetus. And a deficiency of protein in the long run will have an impact on the cause of malnutrition in pregnant women.

The strength of this study was the strong methodology, which was performed using PPS in the sampling, which could represent the situation in that area. However, the cross-sectional design demonstrated in this study limits our ability to establish causality; therefore, future longitudinal studies are needed to confirm the direction of the relationships observed. While a 24-hour food recall can be subject to recall bias, we attempted to minimize this by training enumerators thoroughly.

CONCLUSION AND SUGGESTION

This study concludes that the incidence of CED was soaring and tended to be higher than the national prevalence in Indonesia. Parity, economic status, dietary diversity, household food security, dietary pattern, and food taboo were found to be associated with CED among pregnant women. In multivariate analysis, the variables are adjusted for possible confounding factors, such as income, employment status, age, and education level. However, only several variables were found to be related to CED, such as parity, household food security, and food taboo. Ensuring proper nutrition for pregnant women is pivotal to avoid severe outcomes of CED by empowering health workers. Health workers should encourage pregnant women to educate themselves about healthy food consumption during the critical growth periods of life.

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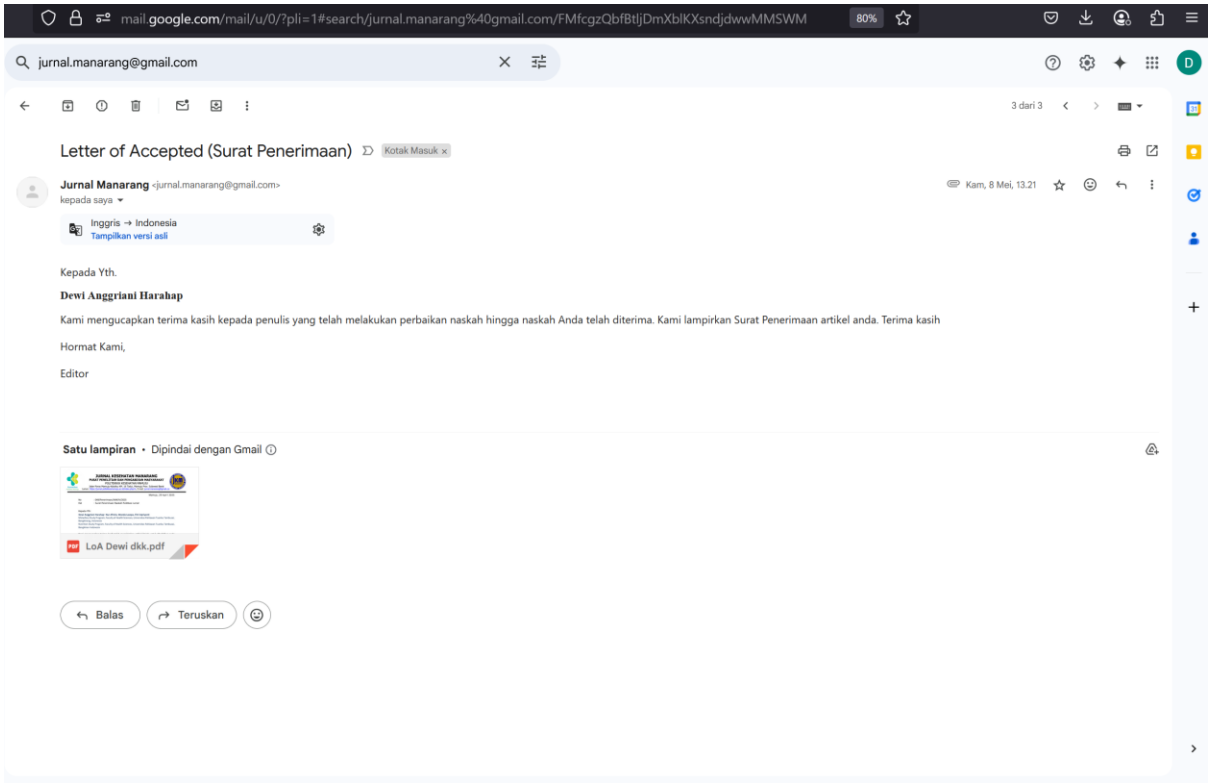
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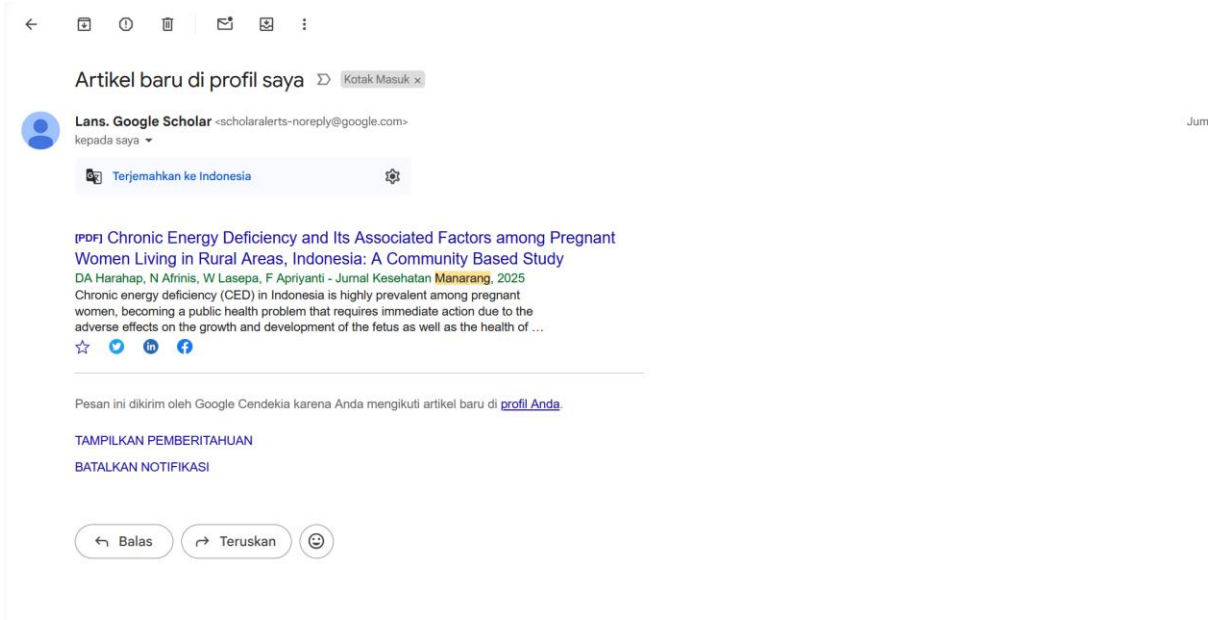
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CHRONIC ENERGY DEFICIENCY AND ITS ASSOCIATED FACTORS AMONG PREGNANT WOMEN LIVING IN RURAL AREAS, INDONESIA: A COMMUNITY BASED STUDY

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ABSTRACT

Chronic energy deficiency (CED) in Indonesia is highly prevalent among pregnant women, becoming a public health problem that requires immediate action due to the adverse effects on the growth and development of the fetus as well as the health of the mother. This study aims to assess factors associated with CED among pregnant women in a particular rural area, in Siak Regency, which has a high prevalence of CED. A cross-sectional study was employed involving 122 pregnant women in the first and second trimesters from December 2024 to January 2025. Probability proportional to size (PPS) was used to select the subjects in 10 villages. Mid-Upper Arm Circumference (MUAC) was measured to determine CED incidence with less than 23.5 cm as a cut-off point. A structured questionnaire was used to collect socio-demographic, food security, and food taboo data. The HFIAS questionnaire was used to collect food security data. This study has found that the prevalence of CED among pregnant women is 35.2%. In bivariate analysis, economic status, dietary diversity, parity, dietary pattern, food security, and food taboo have a significant association with CED. After adjusted by several variables using binary logistic, parity (AOR: 25.47; 95% CI:2.6- 78.23), food security (AOR: 6.19; 95% CI: 2.05- 18.73) and food taboo (AOR: 6.44; 95%CI: 2.0- 20.648) are exhibited to be determinant factors of CED with p-value less than 0.05. The percentage of CED among pregnant women is higher compared to the national prevalence, which leads to urgent actions. Interventions targeting the causes of CED, such as parity, food security, and food taboo, are essential to reduce the incidence of CED. The results of this study are expected to guide policymakers in creating innovative interventions to reduce CED among pregnant women.

Kata Kunci:
Ibu Hamil;
Kekurangan Energi Kronis;
Pantangan Makanan;
Ketahanan Pangan;
Paritas.

ABSTRAK

Kekurangan energi kronis (KEK) di Indonesia sangat umum terjadi pada Ibu hamil sehingga menjadi masalah kesehatan masyarakat yang memerlukan tindakan karena akan menimbulkan dampak yang buruk untuk pertumbuhan dan perkembangan janin serta kesehatan Ibu. Penelitian ini bertujuan untuk menganalisis faktor- faktor yang berhubungan dengan kejadian KEK pada Ibu hamil di wilayah pedesaan di Kabupaten Siak yang memiliki prevalensi KEK yang tinggi. Studi potong lintang dilakukan dengan melibatkan 122 Ibu hamil yang berada pada trimester pertama dan kedua dari bulan Desember 2024 hingga Januari 2025. Probabilitas Proporsional Ukuran Sampling digunakan untuk memilih subjek penelitian yang berada pada 10 desa. Lingkar lengan atas (LiLa) diukur untuk menentukan kejadian KEK dengan kurang dari 23.5 cm sebagai indikator. Kuesioner terstruktur digunakan untuk mengumpulkan data sosio-demografis dan pantangan makanan. Kuesioner HFIAS digunakan untuk mengumpulkan data ketahanan pangan. Studi ini menemukan bahwa prevalensi KEK pada ibu hamil sebesar 35,2%. Pada analisis bivariat, status ekonomi, keberagaman pangan, paritas, pola konsumsi pangan, ketahanan pangan dan pantangan makanan memiliki hubungan yang signifikan dengan KEK. Setelah di kondisikan dengan beberapa variabelmenggunakan analisis logistik binari, paritas (AOR: 25.47; 95% CI:2.6- 78.23), ketahanan pangan (AOR: 6.19; 95% CI: 2.05- 18.73), dan pantangan makanan (AOR: 6.44; 95%CI: 2.0- 20.648) menjadi faktor determinan KEK dengan Pvalue < 0.05. Persentase kejadian KEK pada ibu hamil di wilayah ini lebih tinggi jika dibandingkan dengan prevalensi nasional yang membutuhkan tindakan segera. Intervensi yang menargetkan penyebab KEK, seperti paritas, ketahanan pangan, dan pantangan makanan sangat penting untuk mengurangi kejadian KEK. Hasil penelitian ini diharapkan menjadi panduan bagi pembuat kebijakan untuk membuat intervensi yang inovatif untuk mengurangi angka KEK pada Ibu hamil.

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INTRODUCTION

The first thousand days of life are a critical period that determines the next generation. If this stage is not taken seriously, it would cause irreparable damage to the children, as it is considered a golden period of life (Setia et al., 2021). This period starts from conception until 2 years old. However, pregnant women are prone to suffer malnutrition, particularly anaemia and chronic energy deficiency (CED). CED is a form of malnutrition characterized by prolonged inadequate energy intake leading to nutritional imbalance in pregnant women. If it occurs continuously, it could inhibit the growth and development of the fetus as well as impair the immune system, causing the mother to be more susceptible to infections (K.Wati et al., 2024; Kuntari et al., 2024). Some studies also found that pregnant women with CED had a higher risk of having a baby with low birth weight (Vasundhara et al., 2020; Yosefinata et al., 2022). Thus, immediate actions are required to mitigate severe outcomes in the future by addressing the risk factors.

CED can be measured using mid-upper arm circumference (MUAC) tape, which can be classified if the MUAC is less than 23.5 cm. The measurement of maternal MUAC might assist in estimating the nutritional status of offspring, which can facilitate the implementation of the measures taken to mitigate undernutrition, including the risk of growth faltering and stunting in a family. Despite its feasibility, MUAC is commonly used at the national level to conduct a measurement of child and maternal nutritional status (Haque et al., 2021). According to the data from the Health Survey Indonesia (SKI), the prevalence of CED among pregnant women is alarming. Even though there was a decrease in prevalence from 17.3% in 2018 to 16.9% in 2023 (Indonesia Ministry of Health, 2018, 2023). This nutritional problem remains high. Riau is one of the provinces where most of the pregnant women experience CED, with the prevalence being above the national level (17.9%) (Indonesia Ministry of Health, 2023).

CED is directly caused by inadequate intake of energy and protein for a long time as a result of having a poor food consumption pattern. Individuals' consumption patterns could be identified through examining their daily food intake (Puspitasari et al., 2023). Previous research indicated that pregnant women in Indonesia had lower intake of both energy and protein. This was due to the existence of food taboos among pregnant women that hindered the consumption of these nutrients for a long time (Agustina et al., 2023). Food taboo refers to the condition that some foods are not allowed to be consumed due to several reasons, such as cultural, health, or individual beliefs (Angkasa et al., 2024). These foods included seafoods, starches, and certain fruits and vegetables (Mogi et al., 2024).

Moreover, pregnant women from low socioeconomic families were more likely to experience food insecurity, which makes it more difficult for them to purchase nutritious food (K.Wati et al., 2024). Most households with food insecurity focus mainly on the quantity of food consumed rather than quality, leading to an alteration in dietary patterns (Ramadhani et al., 2021). Considering the high prevalence of CED in Riau, there is a lack of research assessing factors associated with CED in this area, while the number of CED among pregnant women is alarming. To address this knowledge gap, this study aimed to examine all risk factors, such as food taboo, dietary pattern, food diversity, and food security, with CED incidence among pregnant women in a rural area of Bunga Raya district, Siak. The study is expected to help governments and policymakers design interventions targeting pregnant women with CED in rural areas of Riau Province.

METHOD

Type of Research

A cross-sectional study was performed in Siak Regency, Riau Province, Indonesia. Data was collected from December 2024 to January 2025. The target population of this study was pregnant women registered in Bunga Raya Health Centre, Siak. Inclusion criteria of the subjects were pregnant women in their first and second trimesters who lived in the Bunga Raya sub-district and possessed the Mother Child Health (MCH) handbook.

Population and Sample

The selection of sub-districts was done due to the highest prevalence of chronic energy deficiency (CED) among pregnant women. This study was conducted using the probability proportional to size (PPS) method. PPS is a method where the subjects have an equal chance to be selected. Bunga Raya Health Center consisted of 10 villages. The number of pregnant women from each village who participated in this study was based on the proportion of pregnant women in each village. One hundred twenty-two subjects

participated in this study after being calculated using the Slovin formula. Random sampling was employed to select the subjects from each village.

Data Collection

CED data was obtained by measuring Mid-Upper Circumference (MUAC) using MUAC tape. It was classified as CED if the MUAC was less than or equal to 23,5 cm. Socio-demographic data such as education level, employment status, parity, and economic status were gathered using structured questionnaires. Dietary patterns were carried out using the Food Frequency Questionnaire (FFQ), which had been validated through several processes, including food listing and focus group discussion among subjects with similar characteristics. A number of people who participated in this FGD were 10, to discuss food commonly consumed in the last 3 months. A total of 99 food groups were obtained to be asked of the subjects. The score was calculated using the median since the data was not normally distributed, using Kolmogorov-Smirnov. When the score was below the mean/median scores, it was classified as poor. Otherwise, when the score was above the mean/median, it was categorized as a good dietary pattern.

Food taboos information was collected using standardized questionnaires developed by the researchers. Subjects were asked about the availability of food restrictions during pregnancy and the reasons for not consuming related foods. Moreover, food diversity was obtained using the Individual Dietary Diversity Score (IDDS), which comprises nine food groups, including staple foods, dark green leafy vegetables, other fruits and vegetables, meat and fish, eggs, legumes, nuts, seeds, milk, and milk products. The information was obtained using a 2x24-hour food recall. When the subjects consumed certain food groups in amounts greater than 10 grams, it was assigned as 1. Through the IDDS form, if the food groups consumed were fewer than 4 groups, it was classified as less diverse.

Food security was collected using a standardized questionnaire called the Household Food Insecurity Access Scale (HFIAS), which was developed by the Food and Nutrition Technical Assistance Project (Coates et al., 2007). The subjects were asked about household conditions for the past four weeks. The score generated from this questionnaire was 0 to 27. This study was classified into two categories: food-insecure and food-secure households. In addition, this study obtained ethical approval from the Ethics Committee of the Faculty of Medicine, Universitas Muhammadiyah Surakarta 5446/B.1/KEPK-FKUMS/XII/2024. All subjects agreed to participate voluntarily and signed an informed consent form.

Data Analysis and Processing

Enumerators were recruited and selected based on their educational background. Training was conducted among the enumerators regarding MUAC measurement and methods of interview by the researchers. A pre-test of the questionnaire was conducted on 5% of subjects outside the study area who had similar characteristics. During data collection, the researchers undertook supervision. The data were coded and analyzed using software called SPSS version 20. Characteristic respondents were analyzed using descriptive statistics and displayed using tables. Logistic regression was employed to identify factors associated with CED by including variables with a p-value less than 0.25 in bivariate analysis. Adjusted odds ratio (AOR) was obtained to indicate the strength of association with the corresponding 95% confidence interval (CI) using multiple logistic regression. In the end, variables with a p-value of less than 0.05 were considered statistically significant.

RESULT

This study aimed to assess the prevalence and associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition, which is mostly experienced by low-income families. CED could lead to severe birth outcomes such as low birth weight babies, mortality, and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers was found to be approximately 35.2%, which was more likely higher compared to the Indonesia prevalence. Furthermore, several predictors were found to be significantly associated, which were analyzed using multivariate analysis with a P-value < 0.05, including parity, socioeconomic status, household food security, and food taboo.

Table 1 presents that around 66.7% of pregnant women less than 20 years old were CED. This suggests that younger pregnant women are particularly vulnerable to CED in this area. Most of the CED subjects (87.5%) had two children who were under 5 years old, and half of them were elementary school

graduates. This condition leads to a lack of knowledge regarding nutrition, which brings about CED among them. CED pregnant women who were in low-income families accounted for 70%. Regarding dietary diversity, it was profound that there was a significant relationship with CED incidence among pregnant women, in which 56.7% of them had a less diverse diet. Twenty-eight (65.1%) of CED pregnant women were food insecure, almost 53.7% of them had a poor dietary pattern, and 66.7% had food taboos.

Table 1. Characteristic of Subjects and Bivariate Analysis

Variables	CED n (%)	Non CED n (%)	Crude OR	P-value
Ages				
< 20 years old	6 (66.7)	3 (33.3)	2.80 (0.6-3.50)	0.096
20- 35 years old	35 (33.7)	69 (66.3)	1	
>35 years old	2 (22.2)	7 (77.8)	1.775 (0.35- 9.0)	
Parity				
< 3 times	17 (21.3)	63 (78.8)	1	0.000[a]
≥ 3 times	26 (61.9)	16 (38.1)	5.2 (3.6- 10.3)	
Education Level				
Not school	0 (0)	1 (100)		0.670
Elementary school	6 (50)	6 (50)	0.615(0.14-2.58)	
Senior High School	23 (31.5)	50 (68.5)	0.45 (0.2- 0.765)	
University	8 (38.1)	13 (61.9)	1	
Employment Status				
Housewives	37 (38.5)	67 (64.4)	1.1 (0.097- 5.32)	0.948
Civil Servants	5 (36.5)	8 (61.5)	0.92 (0.21- 4.07)	
Private Employee	1 (25)	3 (75)	1	
Economic Status				
Low income (Q1)	21 (70)	9 (30)	3.44 (1.84- 6.420)	0.000 [a]
Medium income (Q2)	16 (26.2)	45 (73.8)	1.45 (0.8- 3.50)	
High income (Q3)	6 (19.4)	25 (80.6)	1	
Dietary Diversity				
Less diverse (≤4 groups)	17 (56.7)	13 (43.3)	3.32	0.009 [a]
More diverse (4 groups)	26 (28.3)	66 (71.7)	(1.41- 7.79)	
Household Food Security				
Food insecure	28 (65.1)	15 (34.9)	7.9 (3.43- 18.5)	0.000 [a]
Food secure	15 (19)	64 (81)		
Dietary Pattern				
Poor	29 (53.7)	25 (46.3)	4.47 (2.02- 9.91)	0.000 [a]
Good	14 (20.6)	54 (79.4)		
Food Taboo				
Yes	26 (66.7)	13 (33.3)	7.76 (3.3- 18.22)	0.000 [a]
No	17 (20.5)	66 (79.5)		

[a] significant association (p-value < 0.05) using chi-square

Table 2 indicates multivariate analysis using logistic regression, with parity, household food security, and food taboo being the determinant factors of CED. Pregnant women who had parity more than 3 were more likely to have a higher risk of suffering CED (AOR: 25.47; 95% CI: 2.60- 315.06). Parity was associated with CED, with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had a higher risk of CED. In addition, household food security showed a significant association with CED among pregnant women; those with food-insecure households had a 6.19 times higher risk of suffering CED (AOR: 6.19, 95% CI: 2.05- 18.73).

Table 2. Multiple Regression of CED among Pregnant Women

Variables	B	S.E	Adjusted OR (95% CI)	P-value
Parity				
< 3 times			1	
≥ 3 times	3.238	1.283	25.47 (2.60- 315.06)	0.012
Household Food Security				
Food secure			1	
Food insecure	1.863	0.594	6.19 (2.05- 18.73)	0.001
Food Taboo				
No			1	
Yes	1.975	0.603	6.44 (2.0- 20.648)	0.002
Constant	-5.890	1.521	0.003	0.000

Analyzed using logistic regression; P-value <0.05; R^2: 0.495; adjusted by economic status, age, education level, and employment status.

DISCUSSION

This study aimed to assess the prevalence and associated factors of chronic energy deficiency (CED) among pregnant women in Bunga Raya Regency. It is profound that CED is part of malnutrition, which is mostly experienced by low-income families. CED could lead to severe birth outcomes such as low birth weight babies, mortality, and stunting (Abubakari et al., 2023; Ekowati et al., 2017). In this study, CED prevalence among mothers was found to be approximately 35.2%, which was more likely higher compared to the Indonesia prevalence. Furthermore, several predictors were identified as significant through multivariate analysis ($p < 0.05$), including parity, socioeconomic status, household food security, and food taboo.

Parity was associated with CED, with adjusted OR 25.47 (2.60- 315.06), in which pregnant mothers with parity more than 2 times had a higher risk of CED. This study aligned with another study conducted by Angkasa et al (Angkasa et al., 2024) that there was a significant association between multiparous women and CED among pregnant women. Having more than 2 pregnancies with close birth intervals would exacerbate the reproductive organs. While the mothers tried to recover by trying to consume adequate nutrient intake, conceiving again led the mothers to become malnutrition (Puspitasari et al., 2023). Short birth interval could cause mother's nutrition depleted that will lead to the higher risk of growth retardation and infants' nutrient storage as well as nutrient delivery through breast.

When a new pregnancy occurred, the current child experienced weaning or reduction in having breastmilk, which made her vulnerable to infection and inadequate intake. However, the association between short birth intervals and breastfeeding was reversible. The termination of breastfeeding causes mothers to become fertile, resulting in another pregnancy (Dewey & Cohen, 2007). However, the current finding indicated a large gap in the confidence interval due to the small sample size. Thus, increasing the sample size is required to minimize the interval.

In addition, household food security showed a significant association with CED among pregnant women; those with food-insecure households had a 6.19 times higher risk of suffering CED (AOR: 6.19, 95% CI: 2.05- 18.73). Food insecurity and malnutrition among pregnant women, which is worsened by gender discrimination, contribute to an intergenerational cycle of nutritional problems (Benson & Shekar, 2006). This result was consistent with other studies (Motbainor et al., 2017; Mukaddas et al., 2021; Ramadhani et al., 2021). Family income is closely related to the incidence of household food insecurity, which affects the purchasing power for nutritious foods (Puspitasari et al., 2023). This suggests that household food security is essential for the daily consumption of all household members since it might contribute to less diverse foods as well as inequality in food distribution among the household members, causing them to have poor dietary intake, leading to undernutrition (Gelebo et al., 2021; Motbainor et al., 2017).

Furthermore, food taboo was found to be a determinant factor of CED among pregnant women. It was found that 66.7% of CED pregnant women were reported to have a food restriction in their community. People living in rural areas have strong beliefs about food consumption, particularly among pregnant and lactating mothers, which will affect their behavior. This will be passed to the next generation, which will contribute to the lack of consumption of certain foods (Nurbaya et al., 2024). Eggs and shrimp were the most restricted food items by pregnant women due to several reasons, such as difficulties when delivering

the babies and abscesses in newborns. These findings were consistent with numerous studies that some animal proteins and certain foods were avoided by pregnant women (Abere & Azene, 2023; Angkasa et al., 2024; Nurbaya et al., 2024). There might be some concerns that consumption of these foods might be associated with the fetal skull, which leads to a larger infant and complications during labor (Tsegaye et al., 2021). Eggs and meat are food sources high in protein required by pregnant women to enhance the weight of the fetus. And a deficiency of protein in the long run will have an impact on the cause of malnutrition in pregnant women.

The strength of this study was the strong methodology, which was performed using PPS in the sampling, which could represent the situation in that area. However, the cross-sectional design demonstrated in this study limits our ability to establish causality; therefore, future longitudinal studies are needed to confirm the direction of the relationships observed. While a 24-hour food recall can be subject to recall bias, we attempted to minimize this by training enumerators thoroughly.

CONCLUSION AND SUGGESTION

This study concludes that the incidence of CED was soaring and tended to be higher than the national prevalence in Indonesia. Parity, economic status, dietary diversity, household food security, dietary pattern, and food taboo were found to be associated with CED among pregnant women. In multivariate analysis, the variables are adjusted for possible confounding factors, such as income, employment status, age, and education level. However, only several variables were found to be related to CED, such as parity, household food security, and food taboo. Ensuring proper nutrition for pregnant women is pivotal to avoid severe outcomes of CED by empowering health workers. Health workers should encourage pregnant women to educate themselves about healthy food consumption during the critical growth periods of life.

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