



Energy Intake and Food Restriction as Determinant Factors of Chronic Energy Deficiency among Pregnant Women in Rural Area of Sungai Sembilan, Riau, Indonesia

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Abstract

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BACKGROUND: Maternal malnutrition is a major public health problem in Indonesia which is shown by high prevalence of chronic energy deficiency (CED) among pregnant women. CED was expressed by the measurement of mid-upper arm circumference (MUAC) showing value less than 23.5 cm.

AIM: This study aimed to identify the factors associated with chronic energy deficiency among pregnant women in rural area, Riau Province.

METHODOLOGY: A community-based cross-sectional study was conducted among 130 samples of pregnant women in Sungai Sembilan Community Health Center in June 2020. Data were collected using structured and field-study questionnaires. Mid-upper arm circumference (MUAC) was measured by MUAC tape. Energy and protein intake were assessed using 24-h food recall. Multiple logistic regression was employed to analyze factors associated with CED using SPSS version 20.

RESULTS: The prevalence of CED among pregnant women was 64.9%. Age of mothers, food restriction, infection disease status, protein, and energy intake were associated significantly with CED. Furthermore, energy intake and food restriction in pregnancy were risk factors of CED (AOR = 3.04, 95% CI: 1.1–8.3 and AOR = 6.73, 95% CI: 1.33–33.9, respectively). We found that proportion of energy intake below 80% RDA and mothers with food restriction was higher among CED group.

CONCLUSION: High prevalence of chronic energy deficiency (CED) was found among pregnant women. Hence, innovative intervention was required to overcome this problem.

Introduction

Maternal malnutrition is a major cause of adverse birth outcomes, such as low birth weight (LBW). It is defined as infants with a birth weight of fewer than 2500 g, which is also determined to cause neonatal mortality and morbidity [1]. Mothers in developing countries have a higher risk of giving birth to infants with low birth weight than mothers in developed countries, as maternal malnutrition is prevalent in developing countries, particularly undernutrition [2]. Moreover, it also results in intergenerational effects that lead to cycles of malnutrition and poverty in the future [3].

Mid-upper arm circumference (MUAC) has been widely used to measure nutritional status among pregnant women, which is also a good predictor for low birth weight [4]. The previous studies had established the cut-off value used for MUAC to identify the risk of acute malnutrition among pregnant women, frequently ranging from 21 to 23 cm [4], [5]. Likewise, the MUAC cut-off point in Indonesia had already been set by the

Ministry of Health, which is valued above equal to 23.5 cm. If the value was lower than 23.5 cm, it was classified as chronic energy deficiency (CED) [6].

In 2018, Basic Health Survey (RISKESDAS) reported that approximately 17.3% of Indonesian pregnant women had chronic energy deficiency (CED) and simultaneously increased (38.5%) in the 15–19 age group [6]. A study found that pregnant women with low MUAC tended to have an insufficient gestational weight gain during pregnancy [7], and it had been caused by the complex interaction of multifactors [8].

Despite the nutritional requirements during pregnancy increased [9], adequate dietary intake was required for pregnant women to support fetal growth and development [10]. Ideally, pregnant women require a minimum additional 300 kcal per day. Likewise, the protein should increase to 20 g per day to assist mothers' growth, fetal tissue, and placenta, as energy and macronutrients intakes provided nutrition for fetal development [11], [12]. In contrast, the dietary intake of Indonesian pregnant women mostly did not satisfy the EAR, making them vulnerable to have a

nutritional problem [13]. Food restriction was also a cause of malnutrition among pregnant women that could lead to insufficient dietary intake [14]. The most common reasons stated were the foods claimed to cause abortion and delayed labor [15]. Another factor influencing pregnant women's nutritional status was infection disease through reducing appetite and dietary intake [16].

This paper aimed to identify the prevalence of chronic energy deficiency (CED) and factors associated with CED among pregnant women in Dumai, Riau Province, to address the gap. These results are expected to bridge the evidence gap on designing a strategy to overcome the malnutrition problem among pregnant women.

Subjects and Methods

Study design

A cross-sectional study was carried out using a quantitative study design in June 2020. The study recruited pregnant women at any stage of pregnancy who lived in a rural area around Sungai Sembilan Community Health Center, Riau Province. It is located 53 km from Dumai city. The zone comprises five districts, which are Bangsal Aceh, Lubuk Gaung, Tanjung Penyembal, Basimbal Baru, and Batu Teritip. Local midwives helped the recruitment with several inclusion criteria: (a) Visited antenatal care (ANC) in Sungai Sembilan Public Health Center; (b) Not suffering any metabolic disorders; and (c) willing to participate in the study. Based on those criteria, a total of 130 samples were involved in this study. Before data collection, the recruited samples were informed about the study's objective. They were also given informed consent as an agreement to follow the study and confidentiality of the data. Furthermore, legal permission was obtained from the local health administrative office.

Anthropometric measurement

Nutritional status data were obtained by measuring MUAC, which was commonly used to determine acute malnutrition among pregnant women in the field setting. It was measured on the left arm using MUAC tape to the nearest 0.1 cm. In this study, pregnant women with MUAC < 23.5 cm were classified as having Chronic Energy Deficiency (CED).

Dietary intake

Moreover, energy and protein intake were collected using the 24-h recall form. These data were analyzed using Nutrisurvey software and compared to

Indonesia Recommended Daily Allowance (RDA) [9]. The energy and protein intakes were classified as inadequate (if the intake was less than 80% RDA) and adequate (if the intake was more than equal to 80% RDA) [17].

Sociodemographic data

To acquire sociodemographic and infection disease data, a face-to-face interview was done by the trained enumerators. Educational level was grouped into primary school, secondary school, and higher and above. Food restriction in pregnancy and infection disease status was divided into "yes" or "no."

Procedures

A principal investigator (PI) recruited trained individuals from the University of Pahlawan Tuanku Tambusai to collect the data, supervise the data collection, and clean the data. In addition, data were checked for clarity and accuracy by the field supervisor. PI conducted double-entry verification to prevent any missing data. All the data were collected using structured and field-tested questionnaires.

Data processing and statistical analysis

Statistical analysis was performed using SPSS version 20. Subject characteristics, bivariate, and multivariate analysis were presented in tables. Bivariate analysis was used to assess the association between two variables. Furthermore, multivariate analysis was used to identify the factors associated with CED among pregnant women after being adjusted by potential confounders. Variables with $p < 0.25$ were included in the multiple regression model through backward. The significance level was considered as $p < 0.05$, and 95% confidence intervals were employed to assess the strength of the effects.

Results

Subjects' characteristics

Table 1 presents the subjects' characteristics. A total of 130 subjects have participated in this study. Almost half of the mothers were aged 19–29 years old and had MUAC less than 23.5 cm (64.9%). Surprisingly, 13.5% of mothers were adolescents and had chronic energy deficiency (CED). The majority of the mothers were in the first trimester (53.1%) and did not have any significant association with CED. From the total subjects, most of the mothers had higher education (53.8%) and did not have any association with CED. In

Table 1: Subjects' characteristics

Variables	Total (n = 130)		MUAC < 23.5 cm (n = 74)		MUAC ≥ 23.5 cm (n = 56)		p
	n	%	n	%	n	%	
Age of mothers							
16–18	10	7.7	10	13.5	0	0	0.000***
19–29	75	57.7	48	64.9	27	48.2	
30–49	45	34.6	16	21.6	29	51.8	
Trimester of pregnancy							
First	69	53.1	39	52.7	30	53.6	0.978
Second	32	24.6	18	24.3	14	25.0	
Third	29	22.3	17	23.0	12	21.4	
Maternal education							
Primary school	14	10.8	8	10.8	6	10.7	0.782
Secondary school	46	35.4	28	37.8	18	32.1	
Higher and above	70	53.8	38	51.4	32	57.1	
Food restriction							
Yes	13	10	13	17.6	4	7.1	0.045*
No	117	90	61	82.4	52	92.9	
Infection disease status							
Yes	15	11.5	15	20.3	2	3.6	0.014*
No	115	88.5	59	79.7	54	96.4	
Energy intake							
Below 80% RDA	102	78.5	64	86.5	38	67.9	0.017*
Above 80% RDA	28	21.5	10	13.5	18	32.1	
Protein intake							
Below 80% RDA	90	69.2	56	76.7	33	58.9	0.036*
Above 80% RDA	40	30.8	17	23.3	23	41.1	

*P < 0.05, ***P < 0.001; Bivariate analysis using Chi-square. MUAC: Mid-upper arm circumference, RDA: Recommended daily allowance (adapted from AKG Indonesia 2019).

addition, this study reported that 10% of total mothers had food restrictions during pregnancy and had a significant association with CED ($p < 0.05$). Regarding infection disease status, 11.5% of mothers had infection disease, and they were shown to have a significant association with CED ($p < 0.05$).

Table 2 summarizes the foods commonly prohibited during pregnancy due to several reasons, such as miscarriage and fear of the abnormality on the baby. Pineapples were found to be major foods avoided by pregnant women as causing miscarriage. Second, fish and seafoods were avoided because it could make the baby smell. Eggs and nuts were believed to cause abscess and allergic of the baby. Finally, cold beverages and durian were known to cause the baby became bigger and obstructed the labor process.

Table 2: Restricted food items and the reasons

Food item	Reasons for restriction
Fish and other seafoods	Causes the baby smell
Pineapples	Miscarriage
Cold beverages and durian	Causes the baby becomes bigger
Eggs and nuts	Causes the baby has abscess and allergic

Table 3 presents mean and median intakes of energy and protein, in comparison with national recommendation (RDA). It indicated that the pregnant women intakes of energy and protein are still far below the national recommendation.

Energy and protein intake

According to Table 1, this study also found that energy intake was associated with MUAC < 23.5cm ($p < 0.05$). The proportion of mothers with energy intake below 80% RDA was significantly higher in the CED group (86.5%) compared to the not CED group. Similarly, protein intake was significantly associated with chronic energy deficiency ($p < 0.05$). CED mothers

Table 3: Mean and median of energy and protein daily intakes among pregnant women

Nutrients	RDA ^a	Mean ± SD	Median (minimum–maximum)
Energy			
Trimester I	2430 kkal	1764.5 ± 482.7	1755.2 (1024.3–5046.9)
Trimester II	2550 kkal	1695.4 ± 305.3	1747.7 (1024.3–2120)
Trimester III	2550 kkal	1820.8 ± 270.9	1783.4 (1442.2–2699.1)
Protein			
Trimester I	61 g	50.1 ± 14.1	47.6 (22.1–104.1)
Trimester II	70 g	46.5 ± 15.9	40.9 (18.3–74.7)
Trimester III	90 g	47.8 ± 13.2	46.5 (15.5–91.3)

^aAdapted from AKG 2019 and for 19–29 years old pregnant women. RDA: Recommended daily allowance, SD: Standard deviation

mostly had protein intake below 80% RDA (76.7%). Moreover, Table 2 presents the mean and median for energy and protein intake of pregnant women. Overall, the mean and median intake of energy and protein intake were lower than RDA for pregnant women.

Factors associated with chronic energy deficiency

Multivariate analysis was demonstrated to analyze factors associated with chronic energy deficiency (CED) among pregnant women. Variables included in this analysis were the age of mothers, food restriction in pregnancy, infection disease status, energy intake, and protein intake since they had $p > 0.25$. The results revealed that energy intake and food restriction in pregnancy were significantly associated ($p < 0.05$) with chronic energy deficiency (Table 4). Mothers with energy intake below 80% RDA had a higher risk of suffering CED (AOR = 2.93; 95% CI: 1.1, 8.1) compared to mothers with energy intake above 80% RDA. Similarly, those who restricted their diet during pregnancy had higher odds to suffer CED (AOR = 7.05; 95% CI: 1.4, 35.8) compared to pregnant women with no food restrictions on their diet.

Table 4: Final results of multivariate analysis on factors associated with chronic energy deficiency

Factors	Adjusted OR (95% CI)	p
Energy intake		
Below 80% RDA	3.04 (1.1–8.3)	0.031*
Above 80% RDA	1	
Food restriction		
Yes	6.73 (1.33–33.9)	0.018*
No	1	

Using logistic regression analysis; *P < 0.05; Adjusted R² was 0.324. OR, final results after adjusted by potential confounders (P < 0.25); CED as a reference. OR: Odds ratio, CI: Confidence interval, CED: Chronic energy deficiency.

Discussion

This study was aimed to determine the associated factors of CED among pregnant women in rural area, Riau Province. In bivariate analysis, the age of subjects, food restriction, infection disease status, energy, and protein intake had a significant association with CED. Meanwhile, in multivariate analysis, energy intake and food restriction during pregnancy were considered to be determinant factors of CED among pregnant women in a rural area, Riau Province.

The risk of CED increased significantly among those who had energy intake below 80% RDA and those with food restriction during pregnancy. Covariates included in analysis were mothers' age, protein intake, and infectious disease status. Besides, this study observed that half of the subjects (56.9%) had MUAC less than 23.5 cm, classified as chronic energy deficiency (CED) and higher when compared to Indonesia national data [6]. Our study also exhibited higher prevalence than other studies conducted in Boyolali and Jakarta, reported 17.1% and 7.3%, respectively [18], [19]. The differences in results might be due to socioculture distinctions, geographical variation, and data collection procedures. Furthermore, other studies also revealed similar results that the prevalence of CED was high in Ethiopia (43.1%) and Bangladesh (46.7%), respectively [20], [21]. Likewise, a study from Cambodia indicated 22.7% of pregnant women had MUAC <23.0 cm [22].

In the present study, energy intake was found to be positively associated with CED among pregnant women after being adjusted by several factors. Pregnant women with energy intake below 80% RDA tended to have 2.93 times higher risk of suffering CED than mothers with higher energy intake. This study was consistent with a study conducted by Madanijah [23] that energy intake among pregnant women in Bogor was ranged from 1447–1678 kcal/day, only satisfying 60–77% of national recommendations. This range was differentiated across socioeconomic status, which increased along with high economic quintiles. According to a study by Rugina (2020), higher energy intake during pregnancy was correlated with excess weight gain that contributed to the mid-upper circumference. However, it should be followed by supervision to prevent maternal obesity [24]. Low MUAC was classified as CED due to the effect of lacking energy intake in the long term [25]. A randomized controlled trial in Bangladesh showed that locally produced food with balanced protein energy contents might reduce the risk of low birth weight as 88.58% among pregnant women with CED. Nevertheless, the percentage of energy from protein should achieve the standard threshold to give a positive effect on birth weight [26], [27].

As noted previously, the second important factor was food restriction in pregnancy. This finding was consistent with another study conducted among pregnant women in Ethiopia that undernourished mothers experienced food aversion during pregnancy. When the mothers averted certain foods, their likelihood of eating diverse foods was lower, leading to reduced daily intake [28]. This finding was also in line with a study in China that pregnant women were more likely to avoid certain foods, such as beef or fish (including eel). Those foods provided an essential nutrient, particularly protein, which also contributed to the baby's growth. Furthermore, this discrepancy was occurred due to sociocultural in each area and family support, which were practiced by rural pregnant women [29].

Strengths and Limitations

To the best of our knowledge, it is the first study to be performed in Indonesia, particularly in Riau Province, that included food restriction during pregnancy into the analysis. In spite of the strength, a few limitations were addressed in this study. Other variables might be associated with CED, which was not measured in this study, such as dietary diversity, nutrition knowledge, and socioeconomic status. Moreover, the sample size of included pregnant women was relatively small and might not represent the general population. Thus, future study needs to be performed in a greater area of Riau Province.

Conclusion

The prevalence of CED among pregnant women in Dumai was relatively high (64.9%) compared to national data. Age of mothers, food restriction, infection diseases status, protein, and energy intake were found to be associated with CED. After adjusting with potential confounders, this study highlighted energy intake and food restriction in pregnancy as essential predictors for CED among pregnant women. Therefore, intervention should be done before pregnancy, particularly among pre-pregnant women (PPW), to prevent undernutrition during pregnancy, and comprehensive maternal education is also recommended.

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