Determinants of Chronic Energy Deficiency among Indonesian Women in The Preconception Period

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Abstract

Purpose: This study aimed to determine the determinants of CED among Indonesian women in the preconception period. _Methodology_: This was a cross-sectional study involving 113 premarital women in Bantul District, Yogyakarta, Indonesia. Determinants of CED studied were socio-demographic factors, knowledge about preconception nutrition, and body mass index (BMI). Socio-demographic background was obtained through a questionnaire. Knowledge about preconception nutrition was measured using a validated questionnaire consisting of 25 questions. Height and body weight were measured using a microtoise and digital scale, respectively. Data were analyzed with Chi-Square test and multiple logistic regression, with statistical significance at α=0.05.

Results: The overall prevalence of CED was 26.5%. Majority of the premarital women were ≤25 years old (65.5%), work (65.9%), and only 24.8% had higher education. The proportion of underweight and overweight was 18.6% and 28.3%, respectively. The result from multiple logistic regression showed that factors associated with CED were age and BMI (Odds Ratio [OR] 8.5, 95% confidence interval [CI] 1.54-45.99; and OR 58.2; 95% CI 11.21-302.09, respectively) _Applications/Originality/Value_: The difference between this research and previous research lies in the research time, research respondents, literature used, and theory used.

Introduction Section

One of the nutritional problems that often occurs during the preconception period is Chronic Energy Deficiency (CED). In Indonesia, based on Basic Health Research (Riset Kesehatan Dasar/RISKESDAS) in 2018, it shows that the prevalence of Chronic Energy Deficiency (CED) in women of reproductive-age who are not pregnant is 14.5% and in pregnant women the prevalence is 17.3% (Kementerian Kesehatan RI, 2019). Chronic Energy Deficiency (CED) is a long-term lack of energy and protein (Afifah et al., 2022). The category of Chronic Energy Deficiency (CED) is based on the mid-upper arm circumference (MUAC) with the interpretation of being at risk of Chronic Energy Deficiency (CED) if the results of the mid-upper arm circumference (MUAC) measurement are < 23.5 cm and not at risk of Chronic Energy Deficiency (CED) if the results of the mid-upper arm circumference (MUAC) measurement are ≥ 23.5 cm.

A woman who starting pregnancy with nutritional problems, including Chronic Energy Deficiency (CED), will have an impact on the health of the mother and the child. Impacts that can occur during pregnancy include impaired fetal growth, susceptibility to infectious diseases, ongoing fatigue, decreased physical strength, affecting the postnatal recovery period, and anemia. Meanwhile, the impact that occurs on children born if a pregnant mother has Chronic Energy Deficiency (CED) is increasing the risk of abortion and birth defects, premature birth, low birth weight (LBW), increasing the infant mortality rate (IMR) and maternal mortality rate (Dean et al., 2014). Several studies also show that maternal health factors can increase the risk of stunting in the children (Dhaded et al., 2020; Santosa et al., 2022).

Preconception is the period before pregnancy occurs. During this period, nutritional support is needed at a higher concentration than in previous periods (Stephenson et al., 2018). Maternal nutritional status plays a role in the fetal growth process and the child's survival in the future (Black et al., 2013). In addition, intergenerational malnutrition can also be caused by the mother's nutritional status during the preconception period (Martorell & Zongrone, 2012). Therefore, optimal women's health in the preconception period is recognized as an important strategy in improving maternal and child health (Lassi et al., 2020). Nutritional readiness during the preconception period really needs to be considered in order to improve

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the health status of mothers and children in Indonesia. However, in reality, nutritional problems among expectant mothers, including Chronic Energy Deficiency (CED), are still high. Our previous study showed that the level of preconception nutritional readiness among premarital women in Bantul were very low (Paratmanitya et al., 2020).

In order to design a good intervention to address Chronic Energy Deficiency (CED), it is important to know the root causes of this malnutrition problem. Sociodemographic conditions are considered important and can be an indirect factor in the occurrence of Chronic Energy Deficiency (CED) (Heryunanto et al., 2022; Parsya et al., 2021; Qudsiya et al., 2022). Sociodemographic conditions may include age, education level, working status, monthly income, knowledge, and education history. Sociodemographic conditions must be monitored because the can effect people's ability to access health services, health behaviors, and the prevalence of risk factors for Chronic Energy Deficiency (CED) (Nölke et al., 2015). With an increased understanding of the relationship between sociodemographic factors and the incidence of Chronic Energy Deficiency (CED), it is hoped that health providers can strive to develop intervention programs and improve the health and welfare of the community, especially in premarital women of childbearing age.

This current study aims to obtain an overview of the preconception nutritional readiness of prospective brides based on mid-upper arm circumference (MUAC), and determine the factors that influence the occurrence of Chronic Energy Deficiency (CED) in premarital women in three sub-districts in Bantul i.e., Dlingo District, Pajangan District, and Imogiri District. These three locations were selected because they have the highest prevalence of stunting in Bantul and study on the health of premarital women in this area is still limited.

Methods

This cross-sectional study was carried out in August-November 2023 in Dlingo District, Pajangan District, and Imogiri District as the three districts with the highest prevalence of stunting in Bantul Regency in 2022. The samples in this study were prospective brides who met the inclusion criteria, namely: (1) not pregnant at the time of data collection; and (2) willing to take part in the research by signing an informed consent. The sample size was 113 premarital women selected using quota sampling techniques.

The independent variables in this study were the sociodemographic characteristics of the women which include age, highest level of education, employment status, and income level. Other independent variables were BMI, level of knowledge about preconception nutrition, and history of preconception nutrition counseling. Sociodemographic variables and counseling history were taken using a questionnaire, while knowledge level variables were measured using a validated questionnaire consisting of 25 questions ($r>0.2816$; Cronbach's Alpha=0,703). Furthermore, knowledge was categorized into two categories, namely "low" if <75% of questions answered correctly, and "high" if ≥75% of questions answered correctly. The BMI variable was calculated based on their height and weight, using a microtoise for height measurement and digital scales for weight measurement. Subjects were grouped into two categories, namely BMI <18.5 kg/m2 and BMI ≥ 18.5 kg/m2.

The dependent variable in this study was mid-upper arm circumference (MUAC), which was measured using a measuring tape with the criteria that if the MUAC was <23.5 cm it was categorized as being at risk of CED and if it was ≥ 23.5 cm it was categorized as not being at risk of CED.

Univariate analysis was carried out to describing the characteristics of the subjects. Then, bivariate analysis was carried out to determine the risk factors for CED, using the chi square test. Next, a multivariate analysis was carried out to determine the most dominant factors influencing the occurrence of CED in premarital women. Multivariate analysis uses logistic regression test.

Ethical Considerations

The ethical clearance of the study was approved by the Research Ethics Committee, The University of Alma Ata Yogyakarta, Indonesia (KE/AA/VIII/10111187/EC/2023). Respondents will receive an explanation from the researcher regarding the research procedure. Research respondents are given the freedom to choose whether or not to be involved in the research. Respondents who agree to be involved in the research are proven by signing an informed consent sheet. This research does not burden respondents and the research data that has been collected is confidential in order to maintain the privacy of respondents.

Results

A total of 113 prospective brides in Bantul Regency were eligible to take part in the study. **Table 1** shows the baseline characteristics of premarital women. The age of premarital women was dominated by those aged ≤25 years (65.5%) and majority had a secondary level of education (61.1%). More than three-quarter (77.9%) of the respondents were currently working and 65.9% have incomes below the district minimum monthly wage. The results also showed that 91.1% of the respondents had low level of knowledge regarding preconception nutrition and 51.3% said that they had received counseling regarding preconception nutrition. The percentage of respondents who were overweight was higher than those

who were underweight. As many as 26.5% of respondents were deemed to be at risk of CED with a mid-upper arm circumference of less than 23.5cm.

Table 1. Baseline Characteristics of the Study Participants (n = 113)

Variable	n	%
Age		
≤ 25 years old	74	65,5
> 25 years old	39	34,5
Education		
≤9 years	16	14,2
10-12 years	69	61,1
>12 years	28	24,8
Working status		
Not working	25	22,1
Working	88	77,9
Income level		
≤ District minimum monthly wage	58	65,9
> District minimum monthly wage	30	34,1
Counseling history		
Have never received counseling	55	48,7
Have received counseling	58	51,3
Level of knowledge		
Low	103	91,2
High	10	8,8
Body Mass Index, mean±SD, kg/m^2	22.85±5.08	
Nutritional Status		
Underweight (BMI<18.5 kg/m^2)	21	18,6
Normal (BMI 18.5 – 25.0 kg/m^2)	60	53,1
Overweight (BMI >25.0 kg/m^2)	32	28,3
Mid-upper arm circumference, mean±SD, cm	26.02±3.90	
Risk of CED		
Yes (< 23.5 cm)	30	26,5
No (≥ 235 cm)	83	73,5

From the results of bivariate analysis (**Table 2**), it was found that there was a relationship between age and the risk of CED in premarital women in Bantul Regency (p-value < 0.05). An Odds Ratio (OR) of 4.74 indicates that subjects aged ≤ 25 years were at risk of CED 4.74 times higher than the subjects aged > 25 years. Regarding to the level of education, there was a significant relationship between the level of education and risk of CED in premarital women (p-value < 0.05). An Odds Ratio (OR) of 3.88 indicates that subjects with a low level of education were at risk of CED 3.88 times higher than the subjects with a high level of education. We also found a significant relationship between the level of knowledge and the risk of CED (p-value < 0.05). An Odds Ratio (OR) of 0.709 indicates that high level of knowledge became a protective factor to be at risk of CED. In terms of body mass index (BMI), there was a significant relationship between BMI and the risk of CED (p-value < 0.05). An Odds Ratio (OR) of 40.0 indicates that subjects with a BMI < 18.5 kg/m2 were at risk of CED 40.0 times higher than the subjects with a BMI ≥ 18.5 kg/m^2.

There was no significant relationship between working status, income level, counseling history, and level of knowledge with the risk of CED in premarital women (p>0.05). Based on the percentage distribution, we found that subjects who were currently working had a greater percentage of CED (28.45%) than subjects who did not work (20.0%). Meanwhile, subjects with income >district minimum monthly wage had a greater CED percentage (30.0%) than subjects with income ≤district minimum monthly wage (27.6%). The percentage of CED was also higher in the group of respondents who had a low level of knowledge and had never received counseling about preconception nutrition.

Table 2. Factors associated with the risk of chronic energy deficiency

Variable	Risk of CED		p-Value	OR (CI)
	Yes (n=30)	No (n=83)		
Age				
≤ 25 years old	26 (35.1)	48 (64.9)	0.004*	4.74
> 25 years old	4 (10.3)	35 (89.7)		(1.52-14.81)
Education				
≤12 years	27 (31.8)	58 (68.2)	0.029*	3.88
>12 years	3 (10.7)	25 (89.3)		(1.08-13.98)
Working status				
Not working	5 (20.0)	20 (80.0)	0.401	0.63
Working	25 (28.4)	63 (71.6)		(0.21-1.86)
Income level				
≤ District minimum monthly wage	16 (27.6)	42 (72.4)	0.812	0.89
> District minimum monthly wage	9 (30.0)	21 (36.2)		(0.34-2.34)
Counseling history				
Have never received counseling	17 (31.0)	38 (69.0)	0.307	1.55
Have received counseling	13 (22.4)	45 (77.6)		(0.67-3.59)
Level of knowledge				
Low	30 (29.1)	73 (70.9)	0.060**	0.71
High	0 (0)	10 (100)		(0.63-0.80)
BMI				
< 18,5 kg/m^2	18 (85.7)	3 (14.3)	0.000*	40.00
≥ 18,5 kg/m^2	12 (13.0)	80 (87.0)		(10.22-156.56)

*) statistically significant ($p<0.05$)
**) analyzed using Fisher Exact Test

Based on the results of the bivariate test shown in table 2, the variables that have a level of significance <0.25 were age, education, and BMI. Although the level of knowledge had a p-value <0.25, it was not included in the multivariate analysis because it had one cell with a value of 0. The results of multiple logistic regression analysis (**Table 3**) show that the factors that significantly associated with the risk of CED were age and body mass index. Body mass index had strongest relationship with the risk of CED, indicated by the largest OR value among the other variables.

Table 3. Multiple logistic regression analysis

Variable	Model 1		Model 2	
	OR	p	OR	P
Age				
≤ 25 years old	7,641	0,020	8,539	0,013
> 25 years old	(1,381-42,265)		(1,586-45,987)	
Education				
≤12 years	1,874	0,442	-	-
>12 years	(0,378-9,284)			
BMI				
< 18,5 kg/m^2	54,355	0,000	58,205	0,000
≥ 18,5 kg/m^2	(10,445-282,842)		(11,214-302,099)	
R^2	0,536		0,531	

Discussion

There were 113 subjects involved in this study and 26.5% of subjects suffered from CED. There needs to be more attention to nutritional status during the preconception period because the mother's nutritional status during the preconception period can cause intergenerational malnutrition (Martorell & Zongrone, 2012). A number of factors that

associated with the risk of CED were found in our study, namely age, education level, knowledge, and body mass index (BMI).

This study revealed a significant relationship between age and mid-upper arm circumference (MUAC). Subjects aged ≤ 25 years had a risk of CED 4.74 times higher than subjects aged > 25 years. In addition, the logistic regression analysis revealed that after controlling another variable, age became one of the factors that had a strong association in determining the subject's MUAC. This research is in line with previous research which found that subjects aged ≤26 years were 2.7 times more likely to experience CED compared to subjects aged >26 years (Nurdin et al., 2018). The reason for this influence is because as people get older, the experience they gain will increase so that they can increase their knowledge which can be the basis for changing behavior in a positive direction to support nutritional status (Patata et al., 2021).

Increased knowledge can be obtained through formal education. Education plays an important role in enabling women to make decisions independently and be accepted by other family members, so that this provides greater access to get the resources that are important for nutritional status (Devgun et al., 2014). This theory is proven in the results of this study which found that subjects with lower level of education are at risk of CED 3,879 times higher than subjects with a high level of education. It also shows that there is a significant relationship between education level and the risk of CED (p-value<0.05). Therefore, there is a need to increase the level of education because only 24.8% of the subjects in this study studied up to university.

Nowadays, the gap no longer exists between women and men. Women have the same rights and opportunities to obtain work. There are many jobs available for women as an effort to support the family's socio-economic conditions. The results of this study show that there was no significant relationship between working status and the risk of CED (p-value > 0.05). Even so, the percentage of women with CED was higher among working women than among non-working women. This was because the subject's high activity level results in higher energy requirements compared to subjects with a low activity level. So, if nutritional needs are not met properly, it can result in the subject's MUAC (Ernawati, 2018).

The purpose of work is to earn income to meet daily needs, including clothing, food and shelter. So, working status is also related to income. Low income makes the subject unable to access food with balanced nutrition. So many cases have been found that a poor wealth index will allow high CED to occur (Dagne et al., 2021). However, this theory is not in line with this research which found that there was no significant relationship between income and risk of CED (p-value >0.05). However, there is previous research that is in line with this research and found that income has no significant effect on the incidence of CED (Febry et al., 2020). Because, even though the subject has a good income and is sufficient to access food with balanced nutrition, there are dietary factors such as low energy and protein consumption habits that can influence it (Musaddik et al., 2022; Widhiyanti et al., 2020).

In this study, there was no significant relationship between counseling history and risk of CED (p-value>0.05). The education provided can increase the level of subject knowledge. Knowledge is basic in three domains of human behavior. The education provided is able to increase knowledge, but it may not necessarily make a good nutritional practices, because this also depends on the attitude taken by the subject after receiving education, whether a positive attitude can have an impact on good nutritional practices as well, or vice versa (Wisdayanti et al., 2022).

After carrying out logistic regression analysis on factors that were significant to risk of CED, it was found that of the three factors in model 1, only age and BMI had a significant effect on risk of CED. Based on R-square value, as many as 53.1% of CED in subjects in this study were influenced by age and BMI and the remaining 56.9% were influenced by other factors. There was a significant relationship between BMI and risk of CED because both have a linear and positive relationship. This was influenced by the composition of the MUAC which consists of fat, muscle and bone so that large MUAC also has a higher fat compositions (Muslimah, 2016). Every 1 cm increase in MUAC in women will increase the BMI value by 0.815 kg/m² (Ariany et al., 2012).

The limitation of this study is that it only looks at the causal factors of CED from sociodemographic conditions. In order to further understand the root cause of CED in Bantul Regency, it is hoped that further research can also find out about the causes of CED not only from sociodemographic factors. Sociodemographic factors are indirect factors that cause CED. Thus, it is hoped thah further research can examine more closely the direct factors that cause CED in Bantul Regency.

Conclusions

There was a relationship between age, education level and BMI with the risk of CED for premarital women in Bantul Regency. Meanwhile, the variables of work status, level of knowledge, educational history and level of income did not have a significant relationship with the risk of CED. Body mass index is the variable that has the strongest relationship with the risk of CED compared to other significant variables. Interventions to improve nutritional status in premarital women should be considered. The Religious Affairs Office is the frontline of the health status of the prospective brides with the Public Health Center as the health facility. From this, it is hoped that the Religious Affairs Office and Public

Health Center can work together to measure the readiness of prospective brides and provide direct intervention if there are prospective brides who are still not nutritionally or healthily ready to enter the conception period.

Acknowledgement

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