

Multilevel Analysis on Factors Associated with Occurrence Chronic Energy Deficiency among Pregnant Women

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ABSTRACT

Background: One of the nutritional problems experienced by pregnant women is chronic energy deficiency (CED). Chronic energy deficiency is a condition in which women of childbearing age experience a lack of energy and protein intake and take place continuously resulting in health problems. This study aims to analyze chronic energy deficiency factors in pregnant women in Gunungkidul Regency.

Subjects and Method: This study implemented a case control design. It was conducted in 25 community health centers, Gunungkidul, Yogyakarta, from April to May 2019. A sample of 200 pregnant women was selected by fixed disease sampling. The dependent variable was chronic energy deficiency in pregnant women. The independent variables included food intake, education level, occupation, knowledge, family income, age, parity, utilization of antenatal care services (ANC), and food availability. The data were collected using the MUAC tape and questionnaire. The data were analyzed by a multilevel multiple logistic regression.

Results: The risk of protein energy deficiency decreased with high energy and protein intake ($b = -2.74$; 95% CI = -7.74 to -1.28; $p = 0.006$), more education level than high school ($b = -2.16$; 95% CI = -4.54 up to -0.22; $p = 0.030$), working mothers ($b = -2.75$; CI 95% = -9.48 to -1.59; $p = 0.006$), sufficient knowledge ($b = -2.32$; CI 95% = -6.27 to -0.52; $p = 0.020$), high family income ($b = -2.38$; CI 95% = -6.27 to -0.60; $p = 0.017$), age ≥ 20 years to 35 years ($b = -2.17$; 95% CI = -5.16 to -0.26; $p = 0.030$), parity > 2 ($b = -2.57$; CI 95% = -8.42 to -1.13; $p = 0.010$), using high ANC services ($b = -2.72$; 95% CI = -9.20 to -1.49 ; $p = 0.007$), and food availability is fulfilled ($b = -2.54$; CI 95% = -7.63 to -0.98; $p = 0.011$). Public health centers had a large contextual influence on chronic energy shortages with an ICC of 51.25%.

Conclusion: There is a significant influence between food intake, education level, occupation, knowledge, family income, age, parity, utilization of ANC services, and food availability for chronic energy shortages in pregnant women. The variations at the public health centers level show that there is a contextual influence on chronic energy shortages in pregnant women.

Keywords: chronic energy deficiency (CED), multilevel analysis, pregnant women

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BACKGROUND

Nutritional problems are still a problem that needs to be considered, one of them is nutrition problems in pregnant women. During the process pregnancy nutritional needs will increase so that women will easily experience nutritional problems. One of the nutritional problems experienced by

pregnant women is chronic energy deficiency (Maryani et al., 2017). Chronic energy deficiency is a condition where women of childbearing age experience a lack of energy and protein intake and take place continuously resulting in health problems (Arisman, 2010).

Chronic energy deficiency is caused by direct factors and indirect factors. The direct factor is the intake of food sources of energy and protein and infectious diseases. Indirect factors include age, parity, level of education, knowledge, occupation, family income, food expenditure, food availability and frequency of presence of ANC (Almatsier, 2009).

Consumption of food that is not sufficient for energy and protein needs or the existence of health problems and a lack of certain nutrients and is allowed to drag on during pregnancy can cause pregnant women to lack chronic energy (Kasim et al., 2019). When pregnant women experience chronic energy deficiency events, it will cause greater danger (Kedir et al., 2016).

Nahar et al. (2009) conducted a study on the effects of giving energy supplementation to pregnant women in Bangladesh showing that supplementation in pregnant women with chronic energy deficiency, increased body weight was more significant than pregnant women with normal nutritional status. This shows that, increasing energy intake will greatly affect the body weight and nutritional status of pregnant women will be optimal.

One of the impacts that can be experienced by pregnant women if protein intake is lacking is that they will experience chronic energy deficiency which is seen based on measurements of upper arm circumference (MUAC) (Irawan et al., 2014). MUAC measurement is an alternative that is easier than body mass index (BMI) in identifying chronic energy deficiency events and more importantly, MUAC is only used for initial screening in pregnant women and cannot be used as a tool for monitoring nutritional status during pregnancy (Chakraborty et al., 2011).

Another factor that affects the incidence of chronic energy deficiency in preg-

nant women is education. The higher the level of education, the easier it is for pregnant women to receive information about nutrition so that the mother's knowledge about the nutrition of pregnant women will be better (Ervinawati et al., 2019). Education also affects income. If higher education is the opportunity to get sufficient income, they can live better and healthier (Department of Nutrition and Public Health, University of Indonesia, 2014).

The level of knowledge is directly related to the age of the mother. Pregnant women who are less than 20 years old are biologically still not stable emotions so that it is easy to experience emotional changes that result in adequate nutrition and socioeconomic fulfillment, pregnant women at a young age will easily experience chronic energy shortages (Abraham et al., 2015). In pregnant women with low socioeconomic status do not have the ability to buy quality or quantity of food compared to people of high socioeconomic status (Noviyanti et al., 2019).

Other factors related to chronic energy deficiency in pregnant women are seasonal or chronic food unavailability at the household level. The availability of food is the ability of the family to fulfill the food needs of all family members in sufficient quantities, both in quantity and nutritional quality (Petrika et al., 2016).

Food availability is very dependent on family purchasing power. If family purchasing power decreases, food availability will also decrease as well and vice versa. If the food availability in the household decreases, the consumption of food and nutrient intake per family member is reduced, causing nutritional problems (Petrika et al., 2016).

Basic Health Research (Riskesdas), in 2018, reported the prevalence of pregnant women experiencing chronic energy defi-

ciency of 20.40%. Profile of the Yogyakarta Special Region Health Office reported an incidence of protein energy shortages of 10.39% and an increase in 2017 to 10.70%. In 2018, the prevalence of chronic energy deficiency is 9.11%. The prevalence of chronic energy deficiency in pregnant women in Gunungkidul Regency in 2014 was 16.38%, a decrease in the incidence of chronic energy shortages in 2016 was 15.83%. In 2016, there was a decline to 15.68%. In 2017, the prevalence of chronic energy deficiency is 15.34% (Gunungkidul District Health Office, 2017).

The prevalence of chronic energy shortages in Gunungkidul from year to year has not changed much in a better direction. Although the incidence of chronic energy deficiency in Gunungkidul Regency shows a lower number than the national target (less than 20%), the chronic energy shortage problem needs to be considered because chronic energy shortages can risk the occurrence of low birth weight (LBW) so that future impacts can increase infant mortality. Low birth weight babies in Gunungkidul Regency are the highest cause of infant mortality.

SUBJECTS AND METHOD

1. Study Design

This study used a case control design. The study was conducted in 25 health centers in Gunungkidul Regency in April-May 2019.

2. Population and samples

The population were all pregnant women in Gunungkidul District health center in April-May 2019. The sampling used was a fixed disease sampling for sampling in pregnant women and cluster sampling for sample pregnancies at the public health center. The sample used by 200 pregnant women came from 8 pregnant women in each level 2 unit (public health center).

3. Study Variables

The dependent variable was chronic energy deficiency. The independent variables were food intake, education level, occupation, knowledge, family income, age, parity, utilization of ANC services, and food availability, and level 2 is a health center.

4. Operational Definition of Variables

Intake consumes energy and protein sources. Eating food sources of energy and protein is the amount of energy and protein from food consumed by pregnant women daily from morning to night, including the type and amount. The measurement scale used was a continuous scale, for the needs of data analysis, it is converted into a dichotomy.

Educational background. The level of education is the education status of the highest school graduation achieved by pregnant women based on the ownership of the last diploma. The measurement scale used was a categorical scale.

Occupation. Occupation is the status of work which is an activity carried out in the home or outside the home which is used as income or making money to fulfill their daily needs. The measurement scale used was a categorical scale.

Knowledge. Knowledge is the mother's knowledge about the nutrition of pregnant women obtained from the answers to the questionnaire, if the correct answer is worth one if the answer is wrong then the value is zero. The measurement scale used was a continuous scale, for the needs of data analysis, it was converted into a dichotomy.

Family Income. Family income is the total amount of family income derived from the income of the head of the family and income of pregnant women, both from full time and part time job in one month and expressed in the value of money or rupiah. The measurement scale requires continuous

scale, for the needs of data analysis, it was converted into a dichotomy.

Age. Age is the age at the time of pregnancy now which is calculated based on the date of birth of pregnant women. The measurement scale was a continuous scale, and for the needs of data analysis, the data was converted into a dichotomy.

Parity. Parity is the number of childbirths that have been experienced by pregnant women both giving birth to living and dead children and influencing the number of family members. The measurement scale was continuous scale, and for data analysis needs, the data was changed to dichotomy.

Utilization of ANC services. Utilization of ANC services is the number of times the subject of research comes to health services both government and private to carry out prenatal checks conducted by health personnel. The measurement scale was continuous scale, and for data analysis needs, the data was changed to dichotomy.

Food availability. The food availability is the food condition of the family of pregnant women available in the last three months. The measurement scale was continuous scale, for the needs of data analysis, the data was converted into a dichotomy.

Chronic energy deficiency. Chronic energy deficiency is a condition in which pregnant women suffer from chronic food shortages or experience chronic energy deficiency which results in health problems in pregnant women which are characterized by results of measurements of upper arm circumference (MUAC) of less than 23.5 cm. The measurement scale is continuous scale, and for data analysis needs, the data is changed to dichotomy.

5. Study Instruments

The data collection technique was done by using primary data and secondary data. Primary data was obtained using a questionnaire. The secondary data was

obtained from the Gunung Kidul District Health Office in the form of data on the number of pregnant women in Gunungkidul Regency.

6. Data Analysis

Univariate analysis was performed to see the frequency distribution and sample characteristics. Meanwhile, bivariate analysis was performed using the chi-square test and calculation of odds ratios (OR) to analyze the relationship between chronic energy shortages and independent variables. Multivariate analysis was performed using multilevel multiple logistic regression analysis. The contextual influence of the public health centers on chronic energy deficiency was indicated by intra class correlation (ICC) values.

7. Research Ethics

Research ethics include informed consent, anonymity, confidentiality and ethical clearance. Ethical clearance in this study was carried out at Dr. Moewardi Surakarta and declared worthy of ethics based on decree number: 456 / IV / HERC / 2019.

RESULTS

1. Sample characteristics

The samples in this study were 200 pregnant women. The frequency distribution characteristics of the samples are described in table 1.

Table 1 shows that 50 pregnant women with chronic energy deficiency (25%), 143 of them with high food intake (71.5%), 144 with higher education levels (72.0%), 148 of working mothers (74.0%), 140 subjects (70.0%) of them with enough knowledge, family income \geq regional minimum wage (UMR) of 137 subjects (68.5%), age at risk of 142 subjects (71.0%), parity \geq 2 amounting to 139 subjects (69.5%), utilization high ANC services amounting to 139 subjects (69.5%), and guaranteed food

availability amounting to 153 subjects (76.5%).

Table 1. Samples Characteristics

Variable	n	%
Chronic energy deficiency		
MUAC <23.5 cm	50	25.0
MUAC ≥23.5 cm	150	75.0
Food intake		
Low (NAR < 70%)	57	28.5
High (NAR ≥ 70%)	143	71.5
Educational background		
Low (≤ Junior high school)	56	28.0
High (≥ Junior high school)	144	72.0
Occupation		
Working	148	74.0
Not working	52	26.0
Knowledge		
Adequate	60	30.0
Inadequate	140	70.0
Family Income		
< Minimum wage (< Rp 1,571,000)	63	31.5
≥ Minimum wage (≥ Rp 1,571,000)	137	68.5
Age		
< 20 years or > 35 years	58	29.0
≥ 20 years to 35 years	142	71.0
Parity		
< 2 children	61	30.5
≥ 2 children	139	69.5
Utilization of ANC services		
Low (TM I and II < 1 time or TM III < 2 time)	61	30.5
High (TM I and II ≥ 1 time or TM III ≥ 2 time)	139	69.5
Food availability		
Poor	47	23.5
Good	153	76.5

2. Bivariate Analysis

Bivariate analysis was conducted to analyze the relationship of the dependent variable (chronic energy deficiency) with the independent variables (energy and protein intake, education level, occupation, knowledge, family income, age, parity, utilization of ANC services, and food availability). The results of bivariate analysis can be seen in table 2. The results of bivariate analysis showed that there was a significant relationship between chronic energy deficiency and energy and protein food intake (OR= 6.01; p<0.001), education level (OR= 7.15; p<0.001), employment (OR= 5.87; p<0.001), knowledge (OR= 3.69; p<0.001),

family income (OR= 7.76; p<0.001), age (OR= 3.99; p <0.001), reality (OR= 4.00; p<0.001), utilization of ANC services (OR= 3.59; p <0.001), and food availability (OR= 4.47; p <0.001).

3. Multilevel Analysis

Multilevel multiple logistic regression analysis was conducted to analyze the effect of independent variables (energy and protein intake, education level, occupation, knowledge, family income, age, parity, utilization of ANC services, and food availability) with chronic energy deficiency dependent variables.

The results of multilevel multiple logistic regression showed that energy and

protein meal intake ($b = -2.74$; 95% CI = -7.74 to -1.28; $p = 0.006$), education level ($b = -2.16$; 95% CI = -4.54 to -0.22; $p = 0.030$), occupation ($b = -2.75$; 95% CI = -9.48 to -1.59; $p = 0.006$), knowledge ($b = -2.32$; 95% CI = -6.27 to -0.52; $p = 0.020$), family income ($b = -2.38$; CI 95% -6.27 to -0.60; $p = 0.017$), age ($b = -2.17$; 95% CI = -

5.16 to -0.26; $p = 0.030$), parity ($b = -2.57$; 95% CI = -8.42 to -1.13; $p = 0.010$), utilization of ANC ($b = -2.72$; 95% CI = -9.20 to -1.49; $p = 0.007$), and food availability ($b = -2.54$; 95% CI = -7.63 to -0.98; $p = 0.011$) had a statistically significant effect on chronic energy deficiency in pregnant women.

Table 2. Bivariate Analysis

Variable group	CED				OR	p
	Yes		No			
	n	%	n	%		
Food Intake						
Low (AKG < 70%)	29	58.0	21	42.0	6.01	<0.001
High (AKG ≥ 70%)	28	18.6	122	81.4		
Educational background						
Low (≤ JHS)	30	60.0	20	40.0	7.15	<0.001
High (≥ SHS)	26	17.3	124	82.7		
Occupation						
Working	27	54.0	23	46.0	5.87	<0.001
Not working	25	16.6	125	83.4		
Education						
Low	26	52.0	24	48.0	3.69	<0.001
High	34	22.6	116	77.4		
Family Income						
< minimum wage (< Rp 1,571,000)	33	66.0	17	34.0	7.76	<0.001
≥ minimum wage (≥ Rp 1,571,000)	30	20.0	120	80.0		
Age						
Risky (< 20 years or > 35 years)	26	52.0	24	48.0	3.99	<0.001
Not risky (≥ 20-35 years)	32	21.3	118	78.7		
Parity						
< 2 children	23	46.0	27	54.0	4.00	<0.001
≥ 2 children	116	77.4	34	22.6		
Utilization of ANC services						
Low	26	52.0	24	48.0	3.56	<0.001
High	35	23.3	115	76.7		
Food availability						
Lacking	23	46.0	27	54.0	4.47	<0.001
Assured	24	16.0	126	84.0		

Community health center had strong contextual effect on chronic energy deficiency with ICC = 51.25%. It indicates that variations in chronic energy deficiency in pregnant women as much as 51.25% are

determined by variables at the puskesmas level. The ICC value in this study is greater than the benchmark 8-10% rule of thumb, so the contextual influence of the public health center is very important to note.

Table 3. The results of multilevel multiple logistic regression analysis

Independent Variables	b	95% CI		p
		Lower Limit	Upper Limit	
Fixed effect				
Energy and protein intake (high)	-2.74	-1.28	-7.74	0.006
Educational background (>SHS)	-2.16	-0.22	-4.54	0.030
Occupation (working)	-2.75	-1.59	-9.48	0.006
Knowledge (good)	-2.32	-0.52	-6.27	0.020
Family Income (\geq Rp 1,571,000)	-2.38	-0.60	-6.27	0.017
Age (\geq 20-35 years)	-2.17	-0.26	-5.16	0.030
Parity (>2 children)	-2.57	-1.13	-8.42	0.010
Utilization of ANC services	-2.72	-1.49	-9.20	0.007
Food availability				
Random effect	-2.54	-0.98	-7.63	0.011
N observation= 200				
N group= 25				
Average of the group= 8, Min=8, Max=8				
Log likelihood= -30.63, p= 0.029. ICC= 51.25%				

DISCUSSION

1. The effect of food intake on CED

The results of this study indicated that the higher the food intake of pregnant women, the lower the risk of chronic energy deficiency in pregnant women. The results of this study indicate that there was a relationship between chronic energy deficiency and was statistically significant food intake.

Women will experience malnutrition based on their intake. Pregnant women with poor food intake because pregnant women pay less attention to fulfilling their own food will have an impact on the nutritional state of pregnant women (Hellyana et al., 2019). Mothers with poor food intake can be indicated that the mother is not fulfilled her nutritional needs so she has the opportunity to have a lack of nutritional status. If this habit lasts long, pregnant women will be at risk of developing CED (Legesse et al., 2019).

2. The effect of education level on CED

The results of this study indicate that the higher the education of pregnant women, the lower the risk of chronic energy deficiency in pregnant women. The results of

this study indicate that there was a statistically significant relationship between the chronic energy deficiency and education.

The results of this study are in line with Ervinawati et al. (2019) stating that there was a statistically significant relationship between the level of education of the mother and the incidence of chronic energy deficiency. A person's level of education will also affect his social life. The higher the education of a person, the more information obtained. The level of education will determine whether or not someone is easy to absorb and understand nutrition and health knowledge (Mahirawati, 2014).

The education status of pregnant women also greatly influences the quality and quantity of food consumption, because with higher education it is expected that knowledge or information about the nutrients they possess will be better. It is because nutritional problems often arise due to ignorance or lack of information about nutrition (Priyanka et al., 2014; Daba et al., 2013).

3. The effect of occupation on CED

The results of this study indicate that pregnant women who work might reduce

the risk of chronic energy deficiency in pregnant women. The results of this study indicate that there was a relationship between chronic energy deficiency and was statistically significant. This study is in line with study conducted by (Mahirawati, 2014) stating that the occupation of a pregnant woman has an influence on the incidence of malnutrition. Working women had the ability to recognize family health problems. Women's knowledge of working on health problems is obtained from books, magazines, newspapers, radio, and television.

Working women had the ability to make decisions to overcome the health problems they face. Women who act as workers as well as wives and housewives generally have better health.

Working mothers have their own income so that to fulfill their nutritional needs, they do not depend on their husbands. Occupation affects the economic status. Health needs such as the fulfillment of health facilities and nutritional needs can be fulfilled if the family has economic capacity (Wong et al., 2018).

4. The effect of knowledge on the CED

The results of this study indicate that the higher the knowledge of pregnant women, the lower the risk of chronic energy deficiency in pregnant women. The results of this study indicated that there was a relationship between chronic energy deficiency and was statistically significant maternal knowledge.

The results of this study are in line with the study of Daba et al. (2013) which states that there is a relationship between knowledge and the incidence of chronic energy shortages. Malnutrition can occur due to a lack of knowledge that a mother has. Malnutrition can occur due to ignorance. Someone who has more knowledge about the nutritional status needed during

pregnancy will be more careful in determining the type of food to be consumed. The level of knowledge of a person's nutrition will affect attitudes and behavior in food selection.

Pregnant women who have knowledge would be more careful in choosing foods to eat. Knowledge is obtained not only from formal education, but can be obtained through health personnel, printed media, and electronic media. Pregnant women who have knowledge when experiencing health problems will find out more about how to deal with the problems they are experiencing (Wong et al., 2018).

Pregnant women who work will recognize their family's health problems. Pregnant women who work have the ability to make decisions to overcome health problems faced. Therefore women who act as workers as well as wives and housewives generally have better health (Ernawati, 2018).

5. The effect of family income on CED

The results of this study indicate that the higher the income of pregnant women, the lower the risk of chronic energy deficiency in pregnant women. The results of this study indicate that there was a relationship between chronic energy shortages and was statistically significant income.

Noviyanti et al. (2019) states that income affect the incidence of chronic energy shortages. Family income reflects the ability of the community in terms of the economy in fulfilling their needs including health needs and fulfillment of nutrients. The level of income determines what food patterns are purchased, the higher the income, the more spending for shopping. This concerns the fulfillment of needs in the family, especially the fulfillment of the need for foods that have adequate amounts of nutritional value (Wong et al., 2018).

Income is the main thing that affects the quality of the menu to be consumed. Low income causes low purchasing power too, so that it is unable to buy food in the amount needed, this condition is very dangerous for family health and ultimately can have a negative impact on the nutritional state of pregnant women (Daba et al., 2013).

6. The effect of age on CED

The results of this study indicate that the higher the age of pregnant women, the lower the risk of chronic energy deficiency in pregnant women. The results of this study indicate that there was a relationship between chronic energy deficiency and age statistically significant.

Pregnant women younger than 20 years had a higher risk of chronic energy shortages, even pregnant women who are too young can increase their risk of chronic energy deficiency. Age is one of the important factors in the process of pregnancy to childbirth, because pregnancy in young mothers causes food competition between the fetus and the mother who is still in its infancy (Mahirawati, 2014).

7. The effect of parity on CED

The results of this study indicate that the fewer parity of pregnant women, the lower the risk of chronic energy deficiency in pregnant women. The results of this study indicate that there was a relationship between chronic energy deficiency and statistically significant parity.

Study results of Ervinawati et al. (2019) show that there is a causal relationship between parity and that which occurs in chronic energy shortages with pregnant women. Families with large numbers of children and close birth spans will cause problems. The income in the family is mediocre and has a large number of family members so that the distribution and adequacy of food in the family is lacking so

that it can cause malnutrition (Bharati et al., 2019).

The number of family members would influence the level of food consumption, namely the amount and distribution of food in the household. The smaller the number of family members, the ability to provide diverse food is also greater because it does not require a large amount of money to buy a variety of foods compared to the number of large family members. However, the number of large family members without being balanced with uneven food distribution will cause these pregnant women to experience chronic energy shortages (Ekowati, 2017).

8. The effect of the use of ANC services on CED

The results of this study indicate that the more frequent pregnant women do antenatal care, the lower the risk of chronic energy deficiency in pregnant women. The results of this study indicate that there was a relationship between chronic energy deficiency and was statistically significant utilization of ANC services.

This is in line with the study of Ghosh et al. (2015) stating that there is an influence between the condition of pregnant women and the utilization of ANC services. When a person is in an unhealthy or disturbed condition, then they will be more aware of using health services sufficiently so that their conditions are good. Pregnant women who experience complaints or complications during pregnancy, they will be more vigilant and more careful in undergoing each process of peace.

Pregnant women who use ANC services will have more knowledge than health workers (Purbaningrum et al., 2019). If pregnant women have a complaint, pregnant women can ask when doing ANC, especially complaints about complications of nutritional intake during pregnancy.

9. The effect of food availability on CED

The results of this study indicated that there was a relationship between chronic energy deficiency and it was statistically significant.

The results of this study are in line with the study of Legesse (2019) which states that there is a relationship between the level of energy intake and food availability with the risk of chronic energy deficiency in pregnant women. This study was conducted in the post-harvest season while the study conducted in Gondar was in the season before harvest. Seasonal differences affect food prices, accessibility, and availability of various foods in the community. Food availability can limit household access to adequate quantity and quality of food which can result in unhealthy nutritional outcomes among family members.

10. The effect of the level of public health centers on CED

The results of this study indicate that community health center had strong contextual effect on chronic energy deficiency with ICC= 51.25%.

The public health center is the leading health care unit directly under the coordination and guidance of the central government. PHC provides integrated services including MCH, family planning, immunization, nutrition, and treatment of diarrhea. One of them is providing services, monitoring the nutritional status of mothers during pregnancy, to prevent the occurrence of health problems that can cause death to both mothers and infants (Bappenas, 2018).

AUTHORS CONTRIBUTION

Nur Cahya Rachmawati is the main author who played a role in collecting and processing the data. Yulia Lanti Retno Dewi examined the conceptual framework and

methodology. Vitri Widyaningsih examined the manuscript.

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CONFLICT OF INTEREST

There is no conflict of interest.

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