

## The Relationship between Chronic Energy Deficiency and the Incidence of Anemia in Female Adolescent in Stunting Locus Areas

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### ABSTRACT

**Background:** Adolescent girls are a group that is prone to anemia, so they are at risk of giving birth to stunted children. This study aims to analyze the factors most associated with the incidence of anemia in adolescent girls in the stunting locus area.

**Subjects and Method:** This was a cross sectional study conducted in Patokaan Village, North Minahasa Regency, North Sulawesi. A total of 50 adolescent girls were selected in this study. The dependent variable was anemia. The independent variables were nutritional status, Chronic Energy Deficiency (CED), nutrient intake (Fe, protein, vitamin C), body perception (Body Image), nutritional knowledge, and menstrual patterns based. The variables studied were anemia based on laboratory examination, nutritional status according to BMI/A and CED using anthropometric methods, nutrient intake (Fe, protein, vitamin C) using 24-hour recall, body perception (Body Image), nutritional knowledge, and menstrual patterns based on questionnaire interviews. Fisher's Exact Test was used for bivariate analysis and logistic regression for multivariate analysis.

**Results:** Adolescent girls with CED have a 5.21 times risk of experiencing anemia compared to those without CED, and this result was statistically significant (aOR= 5.21; 95% CI= 1.01 to 26.83; p = 0.048).

**Conclusion:** CED is associate with anemia in adolescent girls in the stunting locus area. This study is expected to be useful for the North Minahasa District Health Office as input for policy makers, planning, and implementing public health nutrition programs.

**Keywords:** anemia, chronic energy deficiency, adolescent girls.

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### BACKGROUND

Anemia is a nutritional problem that has currently received attention from the government. Based on Riskesdas data (2018),

the prevalence of anemia in teenagers is 32%, meaning that 3-4 out of 10 teenagers suffer from anemia. Anemia in rural areas (22.8%) is higher than in urban areas

(20.6%) (Ministry of Health of the Republic of Indonesia, 2018b).

Anemia can be caused by nutritional deficiency factors through diet or inadequate absorption of nutrients for a long time or chronic lack of energy, body image, infections (eg malaria, parasitic infections, tuberculosis, HIV), inflammation, chronic diseases, gynecological conditions and obstetrics, as well as inherited red blood cell disorders, and trauma or injury that causes Hb levels to decrease.

In developing countries, 40% of anemia is caused by iron deficiency, known as iron nutritional anemia. Adolescent girls who suffer from anemia are at risk of becoming anemic women of childbearing age and subsequently becoming anemic pregnant women who are at high risk of giving birth to stunted children (Ministry of Health of the Republic of Indonesia, 2016). Stunting is one of the main nutritional problems in Indonesia so it needs to be prevented from adolescence considering that teenage girls are prospective mothers who will become pregnant and give birth.

In 2018, the highest number of stunting cases in North Minahasa Regency was found to be in North Sulawesi with a figure of 35.44%, so this district was chosen as the focus area for stunting intervention. The selection of focus locations for stunting intervention at the district/city level is based on a number of indicators, including the number of stunted toddlers. This study aims to analyze factors related to anemia in young women in the Stunting locus area.

## SUBJECTS AND METHOD

### 1. Study Design

The design of this study is analytical observational, using a cross sectional approach. This study was conducted in Patokaan village, North Minahasa district, North Sulawesi from April to October 2023.

### 2. Population and Sample

The population in this study were all young women in Patokaan village, North Minahasa district with a total of 60 young women. Sampling in this study used a purposive sampling technique, namely young women who met the research criteria. The sample for this study consisted of 50 people who were willing to be subjects, aged 12-19 years, menstruating, not pregnant and not suffering from illness.

### 3. Study Variables

The dependent variable is anemia. The independent variables are nutritional status, Chronic Energy Deficiency (CED), nutritional intake (Fe, protein, vitamin C), Body Image, knowledge about anemia, and menstrual patterns (menstrual cycle, duration of menstruation, amount of blood during menstruation).

### 4. Operational Definition of Variables

**Anemia** is a condition of the body where the level of hemoglobin (Hb) in the blood is lower than normal. Nutritional status is a condition of the body resulting from consuming food and drinks and the use of nutritional substances measured using the BMI/U index.

**Chronic Energy Deficiency** is the length of the upper arm circumference of young women measured with a LiLA measuring tape.

**Body Image** is a combination of the thoughts and feelings a person has about their body, namely anxiety about becoming fat by measuring an individual's awareness of body weight, tendency to diet, and restrict eating patterns.

**Protein intake** is the amount of protein consumed for two days. Iron intake is the amount of iron consumed for two days.

**Vitamin C intake** is the amount of vitamin C consumed for two days. Knowledge about anemia is everything that young women know related to anemia.

**Menstrual pattern** is a series of menstrual processes based on the cycle, duration and amount of blood excreted per day.

**The menstrual cycle** is the time from the first day of menstruation until the next menstrual period arrives.

**Menstrual duration** is the length of menstruation based on the number of days in the subject's menstrual cycle each month.

**The amount of blood during menstruation** is the amount of blood released per day during menstruation based on the number of sanitary napkins changed.

### 5. Study Instruments

The data collected was anemia data, by taking venous blood to measure hemoglobin levels using an automated hematology analyzer (Sodium Lauryl Sulphate Hemoglobin) method carried out by health laboratory staff. Nutritional status data is measured based on anthropometric BMI/U and Chronic Energy Deficiency (KEK) through measurement of Upper Arm Circumference (LiLA) using the LiLA tape. Nutritional intake data (Fe, protein, vitamin C) was collected using food recall, and body image assessment variables were carried out using the Multidimensional Body-Self Relations Questionnaire-Appearance Scale (MBSRQ-AS) questionnaire, nutritional knowledge, menstrual patterns were carried out interviews with questionnaires whose reliability has been tested.

### 5. Data analysis

Data analysis included univariate, bivariate Fisher's Exact test, and multivariate analysis based on logistic regression.

### 6. Research Ethics

This study has received ethical approval from the Manado Ministry of Health Polytechnic Health Research Ethics Committee No. KEPK. 01/06/076/2023.

## RESULTS

### 1. Characteristic Sample

The study results in Table 1 show that 26% of young women have anemia. Subjects generally had good nutritional status (92%), but 60% of young women experienced Chronic Energy Deficiency (CED), and 100% did not comply with taking blood supplement tablets. The body image subscale of anxiety about being fat has the most negative image (50%), and the majority of young women are lacking in protein intake (84%), iron intake (94%), and vitamin C intake (94%). Although the level of knowledge about anemia in adolescent girls is classified as good (60%).

### 2. Bivariate Analysis

Table 2 shows that the incidence of anemia in adolescent girls can significantly increase with the presence of CED (OR= 5.21; 95% CI = 1.01 to 26.82; p= 0.035). The incidence of anemia in adolescent girls can also increase with poor knowledge of anemia (OR= 1.09; 95% CI= 0.29 to 3.98; p= 1.000); over nutritional status (OR= 3.62; 95% CI= 0.18 to 72.07; p= 0.561), but this result was not statistically significant. Meanwhile, the incidence of anemia in young women can decrease with the perception of anxiety about becoming fat (OR= 0.51; 95% CI= 0.13 to 1.97; p= 0.476); insufficient protein intake (OR = 0.35; 95% CI= 0.03 to 3.22; p= 0.622); insufficient iron intake (OR=0.36; 95% CI= 0.03 to 3.22; p= 0.558); Insufficient vitamin C intake (OR= 0.06; 95% CI= 0.03 to 3.22; p = 1.000); menstrual cycle >30 days (OR= 0.44; 95% CI= 0.11 to 1.72; p = 0.281); menstrual duration >7 days (OR= 0.33; 95% CI= 0.01 to 5.75; p= 0.456); amount of blood during menstruation (change sanitary napkins >5 times) (OR= 0.19; 95% CI= 0.01 to 5.75; p= 0.103).

**Table 1. Sample Characteristics**

Variable	Frequency (n)	Percentage (%)
<b>Anemia Occurrence</b>		
Anemia	13	26.0
Not Anemic	37	74.0
<b>Nutritional status</b>		
Not enough	0	0.0
Good	46	92.0
Overweight	4	8.0
Obesity	0	0.0
<b>Lack of Energy Chronicle (KEK)</b>		
SEZ	30	60.0
Not KEK	20	40.0
<b>Obedience TTD consumption</b>		
Obedient	0	0.0
Not obey	50	100.0
<b>Perception Body (Body Image)</b>		
Positive	36	72.0
Negative	25	50.0
<b>Protein Intake</b>		
Not enough	42	84.0
Enough	8	16.0
<b>Intake Substance Iron</b>		
Not enough	47	94.0
Enough	3	6.0
<b>Vitamin C Intake</b>		
Not enough	47	94.0
Enough	3	6.0
<b>Anemia Knowledge</b>		
Good	30	60.0
Not good	20	40.0
<b>Menstrual Pattern</b>		
<b>Cycle Menstruation</b>		
28-30 days	37	74.0
>30 days	13	26.0
<b>Duration Menstruation</b>		
2-7 days	48	96.0
>7 days	2	4.0
<b>Amount During Menstruation (Change Sanitary Pads)</b>		
2-5 times	45	90.0
>5 times	5	10.0

**Table 2. Analysis results bivariate about factor determinant incidence of anemia in adolescent’s daughter**

Variable	Anemia				Crude OR (95% CI)	p
	Yes		No			
	n	%	n	%		
Knowledge Anemia						
Not good	5	10	15	30	1.09 (0.29 – 3.98)	1,000
Good	8	16	22	44		
Nutritional status						
More	0	0	4	8	3.62 (0.18 – 72.07)	0.561
Good	13	26	33	66		
Lack Energy Chronicle (SEZ)						
SEZ	11	22	19	38	5.21 (1.01 – 26.82)	0.035
Not KEK	2	4	18	36		
Perception Worry Become Fat						
Negative	5	10	9	18	0.51 (0.13 – 1.97)	0.474
Positive	8	16	28	56		
Protein Intake						
Not enough	12	24.0	30	60.0	0.35 (0.03 – 3.22)	0.662
Enough	1	2.0	7	14.0		
Intake Substance Iron						
Not enough	13	26.0	34	68.0	0.36 (0.01 – 7.55)	0.558
Enough	0	0.0	3	6.0		
Vitamin C Intake						
Not enough	12	24.0	33	66.0	0.68 (0.06 – 6.78)	1,000
Enough	1	2.0	4	6.0		
Cycle Menstruation						
>30 days	5	10	8	16	0.44 (0.11 – 1.72)	0.281
28-30 days	9	16	29	58		
Duration Menstruation						
> 7 days	1	2	1	2	0.33 (0.01 – 5.75)	0.456
2-7 days	12	24	36	72		
Amount During Menstruation (Change Sanitary Pads)						
> 5 times	3	6	2	4	0.19 (0.02 – 1.30)	0.103
2-5 times	10	20	35	70		

Table 3 shows that there is an influence of CED and the amount of blood during menstruation (changing sanitary napkins >5 times) on the incidence of anemia in adolescent girls, and this result is statistically significant. Adolescent girls with CED have a 5.21 times risk of experiencing anemia compared to those without CED, and this result is statistically significant (OR=

5.21; 95% CI= 1.01 to 26.83; p = 0.048). Adolescent girls with a lot of blood during menstruation (changing pads >5 times) have a 4.78 times risk of experiencing anemia compared to changing pads 2-5 times, but this result is not statistically significant (OR= 4.78; 95% CI= 0.90 to 25.29; p = 0.149).

**Tabel 3. Results of multiple logistic regression of the influence of CED and the amount of blood during menstruation (changing sanitary napkins) with the incidence of anemia in adolescent girls**

Variable Independent	OR	95%CI		p
		Lower limits	Upper limits	
Lack of Energy Chronicle (KEK)	5.21	1.01	26.83	0.048
Current blood count Menstruation (replace dressing >5 times)	4.78	0.90	25.29	0.149

N observations = 50  
 -2 log likelihood = 50.28  
 Nagelkerke R<sup>2</sup> = 19.2%

## DISCUSSION

### 1. Characteristics Subject

Adolescent girls are at risk of developing anemia, as is known from this study, 26% of adolescent girls experience anemia, that is, hemoglobin (Hb) levels in red blood cells are lower than normal limits. Hemoglobin is a protein that carries oxygen throughout the body's tissues. The body is unable to obtain oxygen according to its needs, when a person does not have enough red blood cells or the amount of hemoglobin in the blood is low. Adolescent girls are said to be anemic if Hb < 12 gr/dl.

Nutritional status is the condition of the body as a result of consumption, absorption and use of nutritional substances or a physiological condition resulting from the availability of nutrients in the body (Almatsier, 2004). Each individual requires different nutritional intake between individuals, this depends on age, gender, daily body activity, body weight, and others. Nutritional status is closely related to the food consumed, nutrients, and the body's intake requirements (Supriasa et al., 2016).

Based on the study results, it was found that 42 (84%) female adolescent subjects had insufficient protein intake and 8 (16%) female adolescent subjects had sufficient protein intake. Adolescent girls aged 13-15 years are the age group with the

lowest protein intake, namely an average protein intake of 48.1 grams/day.

Based on the study results, it was found that 47 (94%) subjects had insufficient iron intake and 3 (6%) subjects had sufficient iron intake. Adolescent girls in the 13-15 year age group are the largest age group, with an average iron intake of 4.2 mg/day. Insufficient iron intake in almost all subjects is caused by the diet of young women who rarely consume foods high in iron such as sources of heme iron, namely meat and sources of non-heme iron such as green vegetables, irregular eating frequency or often skipping meals, consuming a food menu that is not varied for daily meals, and eating small portions.

Based on the study results, it was found that there were 47 (94%) subjects who had insufficient vitamin C intake and 3 (6%) subjects who had sufficient vitamin C intake. Adolescent girls aged 10-12 years are the lowest age group consuming vitamin C, namely an average of only 14.8 mg/day. The low intake of vitamin C in almost all female adolescent subjects is due to the fact that young women rarely consume food sources of vitamin C such as those found in vegetables and fruit. Based on the results of interviews with subjects, it is known that young women do not like consuming vegetables and fruit.

Measuring body image using the MBSRQ-AS questionnaire uses the anxiety subscale of becoming fat. If we look at the results of the study, the body perception picture of young women is positive, meaning that the subjects feel satisfied with their appearance. Body image is part of self-concept. The more someone accepts and likes their body, the freer they will feel and feel safe from anxiety so that their self-esteem will increase (Khaeriyah et al., 2015). This can also affect a person's health. A positive body image indicates that there is satisfaction with the condition of one's body so that one will not take action to change one's appearance in an unhealthy way such as going on an extreme diet and limiting the amount of food, resulting in less nutritional intake (Sari et al., 2022).

The results of the study showed that all young women were disobedient in consuming Blood Supplement Tablets (TTD). Compliance with taking blood supplement tablets is measured by the number of doses per week, type of drug, time of consumption and method of consumption. The majority of subjects in this study had good knowledge because information about anemia could be obtained from various sources, namely the media (electronic, print, internet), teachers, family, health workers and friends. Young women who have good knowledge about anemia tend to consume enough food to meet their nutritional needs to avoid anemia problems (Rahayu et al., 2021). Based on menstrual patterns, most subjects had menstrual cycles, duration/length of menstruation, and blood counts within normal limits.

## **2. Bivariate Analysis**

The study results show that the variable associated with the incidence of anemia in adolescent girls is Chronic Energy Deficiency (CED). Chronic energy deficiency is a condition where women of childbearing age

suffer from a lack of calories and protein (malnutrition) which results in health problems. Women who are at risk of CED are those whose Upper Arm Circumference (LiLA) is below 23.5 cm (Ministry of Health of the Republic of Indonesia, 2018a).

Based on study data, the majority of subjects in each subscale had a positive body perception and did not experience anemia. This is because body perception (body image) can influence the occurrence of anemia, however body perception (body image) is an indirect factor in determining anemia status so it is also necessary to look at direct factors such as diet and also the amount of nutritional intake which can directly influence incidence of anemia (Fatimah, 2017).

This is in line with the study of Setyowati et al. (2017), which showed that body image had no relationship with eating behavior in preventing anemia. In fact, the results showed that subjects with positive body perception tended to adopt bad eating behavior in preventing anemia. Young women who are satisfied with the condition of their bodies also tend to experience anemia. Adolescents who have an ideal body will take care of their bodies in every way, such as strict diets, irregular eating patterns and avoiding certain foods, causing reduced iron consumption and causing anemia (Hutasuhut and Supriati, 2022).

The study results show that there is no relationship between protein intake and the incidence of anemia in adolescent girls. The protein intake most frequently consumed by young female subjects was chicken eggs, skipjack tuna, tilapia fish, chicken meat, tofu and kale vegetables. Although in this study it is known that young women more often consume food sources of animal protein, this does not guarantee that their protein intake will always be sufficient, because the majority of young women have the habit of not eating in a day or often skipping meals,

eating small portions and consuming an undiverse food menu.

The study results showed that there was no significant relationship between iron intake and the incidence of anemia. It is known that many of the young women studied had insufficient iron intake, namely an average of only 4.7 g/day. These results are in accordance with a study conducted by Nabila et al (2021) on adolescent girls at Bengkulu Middle School which showed that anemia was not influenced by iron adequacy. This can happen because iron enters the body and anemia can be influenced by other factors such as the presence of infectious diseases and inadequate nutritional intake.

In this study, no relationship was found between vitamin C intake and anemia. Other factors can influence the incidence of anemia, such as a history of worms, infectious diseases and the presence of substances that inhibit iron absorption or inhibitor factors consumed by young women, thus affecting the action of vitamin C. Examples of substances that inhibit iron absorption are phytate, oxalate and tannin (Sholihah et al. , 2019). The results of this study are the same as a study on teenage girls at SMA Negeri 5 Malang City, which showed that there was no relationship between vitamin C intake and hemoglobin levels (Habibie et al., 2018).

The results of the Fisher's Exact statistical test show that there is no relationship between nutritional status and the incidence of anemia in adolescent girls. The nutritional status of adolescents in Indonesia includes a lack of macronutrients (carbohydrates, protein, fat) and a lack of micronutrients (vitamins and minerals). Nutritional status is closely related to the food consumed, nutrients, and the body's intake requirements. If the nutritional status is not

normal, it is feared that the iron status will also not be good, which can cause anemia.

The level of knowledge can indirectly influence anemia status, so it is necessary to look at direct factors such as diet and nutritional intake which can directly influence the occurrence of anemia. The results of this study show that there is no significant relationship between knowledge about anemia and the occurrence of anemia in young women.

Most subjects' menstrual cycles were in the normal category, namely 28-30 days. For Menstrual Duration, the majority of subjects had a normal duration of 2-7 days, and the subjects' blood counts were in the normal category. The study results showed that based on menstrual patterns, namely the menstrual cycle, duration of menstruation and the amount of blood during menstruation, there was no significant relationship with the occurrence of anemia.

### **3. Multivariate Analysis**

Chronic energy deficiency (CED) is a body condition characterized by underweight and low energy stores, the possibility of limited physical capacity due to lack of food for a long period of time and having a body mass index of less than 18.5 kg/m<sup>2</sup>.

Chronic energy deficiency can disrupt various metabolic processes in the body, including the growth process, energy production process, immune function, as well as changes in brain function and structure. One of the impacts is disrupting the function of energy metabolism processes and iron stores. A long-lasting decrease in energy metabolism can reduce iron stores in the body (Bastian et al., 2019).

The results of a study conducted on women of childbearing age in rural Kebeles, North West Ethiopia, concluded that the frequency of eating infrequently, the absence of a yard at home, the absence of latrine facilities, a large number of family members,

and low educational status were the factors that caused chronic energy deficiency (Wubie et al., 2020).

Chronic Energy Deficiency (CED) is a condition where teenagers experience malnutrition that lasts for a long time and diet is one of the factors that plays an important role in the occurrence of CED. A good consumption pattern refers to balanced nutrition, namely that all nutrients are met by the body according to needs. Most young women are afraid of getting fat or feel embarrassed if they have a fat body, so they try to have a slim body by reducing food portions and this can result in young women lacking nutrients, including iron, which can cause anemia (Mutmainnah et al., 2021).

#### **AUTHOR CONTRIBUTION**

All authors have made significant contributions to data analysis as well as preparing the final manuscript.

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#### **CONFLICT OF INTEREST**

There is no conflict of interest in this study

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