Jurnal Gizi dan Dietetik Indonesia
(Indonesian Journal of Nutrition and Dietetics)
Vol 13, Issue 4, 2025: 296-303

Available online at: https://ejournal.almaata.ac.id/index.php/IJND
p-ISSN 2303-3045 e-ISSN 2503-183X
DOI: https://dx.doi.org/10.21927/ijnd.2025.13(4).296-303

The relationship between nutritional intake with the incidence of Chronic Energy Deficiency (CED) of teenagers in urban and rural areas

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ABSTRAK

Latar Belakang: *: Kurang energi kronis (KEK) adalah kondisi kekurangan energi dan protein dalam jangka waktu lama yang umumnya terjadi pada remaja putri atau Wanita Usia Subur. Masalah ini perlu mendapat perhatian karena dapat menimbulkan dampak serius dalam jangka panjang. Kondisi ini menonjol pada remaja putri usia 15-19 tahun dan dapat diidentifikasi melalui pengukuran lingkar lengan atas (LILA) <23,5 cm. Asupan zat gizi yang tidak memenuhi mencukupi merupakan faktor langsung penyebab KEK, yang dapat menyebabkan penurunan berat badan, dan jika berkelanjutan berisiko memperparah kondisi KEK.*

Tujuan: *Menganalisis hubungan asupan zat gizi terhadap kejadian kurang energi kronis pada siswi SMA di wilayah urban dan rural Kabupaten Kediri.*

Metode: *Metode penelitian yang digunakan yaitu observasional analitik dengan design case control, sampel terdiri dari enam SMA yang dibagi menjadi tiga SMA di wilayah urban dan tiga SMA di wilayah rural dengan total sampel 144 siswi masing-masing sekolah 24 sampel. Pengumpulan data menggunakan kuesioner food recall 2x24 jam yang diambil pada saat weekday dan weekend. Analisis data menggunakan SPSS dengan chi-square.*

Hasil: *Hasil penelitian menunjukkan hubungan yang signifikan antara asupan zat gizi pada wilayah urban asupan energi (p=0,000), protein (p=0,03), karbohidrat (p=0,000) dan lemak (p=0,04) dan wilayah rural asupan energi (p=0,000), protein (p=0,018), karbohidrat (p=0,000) dan lemak (p=0,018) dengan kejadian kurang energi kronis pada siswi SMA di Kabupaten Kediri.*

Kesimpulan: *Asupan zat gizi (asupan energi, protein, karbohidrat dan lemak) sebagai penyebab kurang energi kronis (KEK) sehingga dapat dijadikan acuan untuk mencegah mengalami kurang energi kronis.*

KATA KUNCI*: asupan zat gizi; kurang energi kronis; siswi; SMA*

ABSTRACT

Background: *Chronic energy deficiency (CED) is a condition in teenage girls or women of reproductive age who are experiencing long-term energy and protein deficiencies. CED is still a nutrition problem in teenagers that must be addressed because it has serious long-term impacts. The most prominent CED occurs at the age of 15-19 years, especially in adolescent girls. CED can be seen from the size of the upper arm circumference (MUAC) <23.5 cm Nutritional intake is a direct factor that causes CED. Lack of nutritional intake that does not meet needs can result in weight loss and if it continues can result in chronic energy deficiency.*
Objectives: *to analyze the relationship between nutritional intake and the incidence of chronic energy deficiency in female high school students in urban and rural areas of Kediri Regency.*
Methods: *The research method used is analytical observational with case control design, the sample consists of six high schools which are divided into three high schools in urban areas and three high schools in rural areas with a total sample of 144 students, each school has 24 samples. Data collection used a 2x24 hour food recall questionnaire taken on weekdays and weekends. Data were analyzed using SPSS Version 26 with chi-square.*
Results: *The results showed that there is a relationship between Nutrient intake in urban areas (energy intake (0.000), protein (0.03), carbohydrates (0.000 and fat (0.04)) and rural areas (energy intake (0.000), protein (0.018), carbohydrates (0.000 and fat (0.018) with the incidence of chronic energy deficiency in female high school students in Kediri Regency.*
Conclusions: *Therefore, female students can know that nutritional intake (energy, protein, carbohydrate and fat intake) is the cause of chronic energy deficiency (CED) so that it can be used as a reference to prevent experiencing chronic energy deficiency.*

KEYWORD*: nutrient intake; chronic energy deficiency; female students; high school*

Article info:
Article submitted on September 26, 2024
Articles revised on October 24, 2024
Articles received on May 09, 2025

INTRODUCTION

The teenager period is a transition period from childhood to adulthood that occurs in a person who is in the age range of 10-18 years, while according to WHO adolescence occurs at the age of 10-19 years. Adolescence is a period of rapid growth and development, also known as growth spurt (1). In addition, during the adolescence period there is also a special process in the life phase, namely the process of maturity in the reproductive organs (2). During adolescence, it is not uncommon to experience nutritional problems including malnutrition, chronic energy deficiency (CED), obesity and anemia (3). CED is a major nutritional problem among adolescent girls, requiring urgent attention to prevent long-term consequences (4). CED is adolescence increases the risk of hormonal disorders and infectious diseases, which can negatively impact overall health (2).

Chronic energy deficiency (CED) is a condition of teenage girls or women of reproductive age (WRA) experiencing energy and protein deficiency problems for a long period of time or annually (5). CED also occurs due to an imbalance between energy needs and daily food intake that lasts for a long time (6). Low energy and protein intake can also contribute to low micronutrient intake. In addition, teenage girls who have a BMI below normal for a long period of time can also cause chronic energy deficiency (CED). Chronic energy deficiency in Indonesia uses the indicator of Upper Arm Circumference (LILA) measurement. A person who experiences CED has a LILA measurement result of <23.5 cm (7).

Chronic energy deficiency in Indonesia has a fairly high prevalence. The prevalence of CED based on SKI 2023 in Indonesia at the age of 15-19 a long time has the most noteworthy prevalence, especially in women of reproductive age who are not pregnant, which is 41,9%. The prevalence in East Java Province at the age of 15-49 not pregnant was 19,7% (8). The prevalence of chronic energy deficiency in Kediri Regency in adolescents is still relatively high. CED is caused by both direct and indirect factors. Direct factors include macronutrients (energy, carbohydrates,

protein, fat) and the presence of infectious diseases. Meanwhile, indirect factors include socioeconomic aspects such as pocket money, body image, physical activity, nutritional knowledge, maternal education, and parental income (9). Cultural influences, heredity factors, lifestyle, and environmental conditions also play significant roles in CED incidence (10).

The impact that can be caused if teenagers experience chronic energy deficiency is almost the same as experiencing anemia, including low endurance, reduced learning concentration, organ development and not optimal activity (11). Teenagers who experience CED and continue into adulthood and experience pregnancy will have an impact on the fetus and mother. The impact if they get pregnant is that they can give birth to low-weight babies (LBW), premature, anemia in the fetus, defects and can reach the death of babies in the womb (12). In addition, the children born to mothers with CED can also experience stunting as adults (13). Based on this exposure, further research was conducted related to nutritional intake (energy, protein, carbohydrates and fat) on the incidence of CED. Given the high prevalence and multiple risk factors of CED, further research is needed to understand its relationship with nutrient intake among high school students in different geographic settings.

Based on demographic data and previous research, there are various differences in demographic conditions and causal factors in urban and rural areas. However, the handling that has been carried out in the field does not pay attention to this. This has caused the prevalence of CED in the last five years to increase by around 5%. Therefore, the study aims to determine the relationship between nutritional intake (energy, protein, carbohydrate and fat intake) on the incidence of chronic energy deficiency (CED) in female high school students in urban and rural areas of Kediri regency.

MATERIALS AND METHODS

The type of research used was analytic observational with case control design. The study population consisted of female students located in urban and rural areas consisting of six schools, namely SMAN 1 Pare, SMAN 2 Pare, SMAN 1 Grogol, SMAN 1 Papar, SMAN 1 Purwoasri and SMAN 1 Plemahan. The selection of high schools used a random sampling technique because there is no specific data for each high school in Kediri Regency. The sample size was calculated using Kesley's formula in the OpenEpi application, yielding a total of 144 students (72 cases and 72 controls), with each school contributing 24 students (12 cases and 12 controls). The sample was selected using a random sampling technique.

Participants were classified into case and control groups based on MUAC (Upper Arm Circumference) measurements, where those with LILA < 23.5 cm were categorized as CED cases, while those with MUAC ≥ 23.5 cm were included in the control group. The inclusion criteria were National Senior High School students, indicated to have CED (MUAC <23.5 cm) in the case group and not indicated to have CED (LILA ≥ 23.5 cm) in the control group, willing to participate in the study until the end and sign informed consent. Meanwhile, the exclusion criteria were being on a fast diet, being sick, vomiting at the time of data collection and taking accelerated classes.

Independent variables included intake of energy, protein, carbohydrate and fat. The dependent variable is CED. The instrument used was a 2 x 24 hour food recall questionnaire to obtain data on energy, protein, carbohydrate and fat intake. Food recall data collection was carried out at two times, namely at the weekend and at the end of the week so that there were no similarities in eating patterns. The results of the food recall were inputted into a nutrisurvey then divided into two and divided by the average to obtain the results of energy, protein, carbohydrate and fat intake. Nutrient intake is categorized into two categories, namely Less and enough. Less category if intake is <77% RDA and enough category if ≥77% RDA. LILA measurement with medline. MUAC size <23.5 is CED and ≥23.5 is not CED.

Data that has been entered is then analyzed using software statistic univariate tests that use the distribution of research energy intake, protein, carbohydrate and fat in the case group and control group. Then the chi-square test was conducted to determine the relationship between the independent variable and the dependent variable. Data collection was carried out in three schools in July-August 2024. The Health Research Ethics

Commission (KEPK) of the Faculty of Medicine, Sebelas Maret University has given ethical approval for research with certificate No: 70/UN27.06.11/KEP/EC/2024.

RESULTS AND DISCUSSIONS

In this study, univariate and bivariate tests were carried out. The results of research on the relationship between energy, protein, carbohydrate and fat intake among female high school students in urban and rural areas in Kediri Regency, data are presented in **Table 1**. Based on **Table 1**, it can be concluded that the average intake of high school students in rural areas is greater than in urban areas, both in the case group and in the control group.

Table 1. Distribution of mean nutrient intake among high school students in the urban and rural area of Kediri regency

Variable	Urban		Rural	
	CED	Non CED	CED	Non CED
Energy Intake	1324.922	1926.5	1431.6	2358.1
Protein Intake	41.544	52.54	44.06	55.65
Carbohydrate intake	50.362	241.3	165.4	248.1
Fat Intake	179.923	73.6	65.8	65.8

Based on the univariate analysis in **Table 2**, most urban areas have protein intake (61.6%) and the majority of carbohydrate intake (62.5%) are in the less category, while energy intake (59.7%) and fat intake (55.6%) is in the enough category. In rural areas, the majority fall into the less category, namely protein intake (55.6%) and carbohydrate intake (69.4%) while in the enough category energy intake (58.3%) and fat (52.8%). Based on the group, in urban and rural areas, the majority of the CED group experienced less energy, protein, carbohydrate and fat intake, while the group without not CED was in the enough category. Bivariate analysis was used to examine the relationship between nutritional intake (energy, protein, carbohydrate and fat intake) with the incidence of CED among female students in urban and rural areas of Kediri Regency. The analysis results are presented in the following table. The results of the research presented in Table 2 indicate a significant association between energy, protein, carbohydrate, and fat intake with the incidence CED in female high school students in urban and rural areas.

Energy intake has a significant relationship with the incidence of CED in urban and rural areas, with a p value=0.000 and an OR=4.9 and OR=5.2. In urban areas, students with low energy intake were 4.9 times more likely to experience CED compared to those with sufficient intake, similarly in rural areathe OR was 5.2. Energy intake remains one of the causes of CED both in rural and urban areas. This occurs because of food restrictions carried out by the individual himself even though the availability of food both in the city and rural high school areas is available and easy to reach. In addition, energy intake is also related to the amount of their pocket money because it is used to meet food intake or needs when outside the home.

This study is in line with investigation conducted on high school and vocational school student respondents in Karangasem Regency, Bali which stated energy intake is related to CED and obtained an OR value of 2.1 (14). In addition, it is also supported by research that there is also a relationship between energy intake and the incidence of CED with an OR value of 4.9 (10). In addition to occurring during teenage years, CED can also occur during pregnancy. This is proven in a study conducted at the Andalas Health Center that lack of energy intake is also associated with the incidence of CED during pregnancy with a p value of 0.011 (15). However, the results of research conducted at SMAN 18 Makassar with the results there is no relationship between energy intake with the incidence of CED with a p=0.211 (16).

Energy intake during teenage years must be met in accordance with the RDA because during the teenage years there are many changes including organ maturation, growth and development that require sufficient energy intake for the (17). The lack of energy intake in adolescents is often caused by an intake deficit that is not in accordance with their needs.

Table 2. Distribution of nutrient intake among high school students in the Urban and Rural Area of Kediri Regency

Variable	Urban				Total (%)	Rural				Total (%)
	CED		Not CED			CED		Not CED		
	n	%	n	%		n	%	n	%	
Energy Intake										
Less (<77% RDA or < 1617 kal/day)	33	91.7%	10	27.8%	43(59.7%)	28	77.8%	2	5.6%	30(41.7%)
Enough(≥77% RDA or ≥ 1617 kal/day)	3	8.3%	26	72.2%	29(40.3%)	8	22.2%	34	94.4%	42(58.3%)
Protein Intake										
Less (<77% RDA or <50gr/day)	26	72.2%	18	50%	44(61.6%)	25	69.4%	15	41.7%	40(55.6%)
Enough(≥77% RDA or ≥ 50 gr/day	10	27.8%	18	50%	28(38.9%)	11	30.6%	21	58.3%	32(44.4%)
Carbohydrate Intake										
Less (<77% RDA or < 231gr/day)	31	86.1%	14	38.9%	45(62.5%)	35	97.2%	15	41.7%	50(69.4%)
Enough (≥77% RDA or ≥ 231gr/day)	5	13.9%	22	61.1%	27(37.5%)	1	2.8%	21	58.3%	22(30.6%)
Fat Intake										
Less (<77% RDA or < 59 gr/day)	22	61.1%	10	27.8%	32(44.4%)	22	61.1%	12	33.3%	34(47.2%)
Enough (≥77% RDA or ≥ 59gr/day)	14	38.9%	26	72.2%	40(55.6%)	14	38.9%	24	66.7%	38(52.8%)

Tabel 3. Bivariate analysis of energy, protein, carbohydrate and fat intake with the incidence of chronic energy deficiency (CED) in female high school students in urban and rural areas of Kediri Regency

Variable	Urban		Rural	
	p-Value	OR (95%CI)	p-Value	OR (95% CI)
Energy Intake	0.000*	4.9 (1.573-14.595)	0.000*	5.2 (1.357-15.147)
Protein Intake	0.03*	2.6 (0.977-6.922)	0.018*	3.18 (1.206-8.398)
Carbohydrate Intake	0.000*	4.5 (1.282-13.371)	0.000*	3.9 (1.376-12.941)
Fat Intake	0.04*	4.08 (1.518-11.000)	0.018*	3.14 (1.199-8.241)

*significant, p value <0.05 Chi-square: OR= Odds Ratio, CI: Confident Interval

Chronic energy deficiency, if it occurs during adolescence and continues into adulthood, will have a negative impact on the body, such as not being able to digest food optimally, decreased immunity, suboptimal absorption of nutrients and can cause frequent infections (18). Apart from that, teenagers who experience chronic energy deficiency can also have long-term impacts, namely decreased muscle mass, bone density, menstruation and cognitive function (19). Protein intake also has a significant relationship with the incidence of CED with a p value of 0.03 urban and 0.018 rural. Female students with less protein intake in urban areas are 2.6 times more likely to experience CED and 3.18 times in rural areas. The results of the food recall that was carried out on respondents included animal or vegetable protein in every meal, but the amount was not all in line with daily needs. In addition, protein intake that is often consumed is vegetable protein. Thus, from the results of the study, education can be provided regarding the need for daily protein intake so that students can meet these needs so that there are no CED nutritional problems. The results of this study are in line with research conducted on adolescent girls aged 12-15 years in Pekon Pamenang that deficiency protein intake is a risk factor for CED with p-value<0.05 (20). Research conducted at MAN 1 Aceh showed chronic energy deficiency with a p value of 0.000 (21).

Low protein intake can also have an impact on less than optimal growth, decreased body resistance and susceptibility to disease (20). Protein intake also functions in bone formation and tissue maintenance. If the body lacks protein intake, it will experience a shortage of materials for bone formation and tissue repair (22). Apart from that, protein intake is also used for daily energy needs. If protein intake is continuously low, reserves will be depleted and the stores will be broken down in the form of muscle or fat, which can cause chronic energy deficiency (12). The next variable, namely carbohydrate intake, also has a significant relationship with a p value of 0.000 with the incidence of CED in high school students in both urban and rural areas with OR 4.5 and OR = 3.9. The OR value means that female students who have less carbohydrate intake have a greater chance of experiencing chronic energy deficiency. In rural areas, the OR value is higher, resulting in female students in high schools in rural areas being more likely to suffer from CED. In a study conducted on adolescents in the Lubuk Kilangan Community Health Center work area in 2022, it was stated that carbohydrate intake also had a significant effect on the incidence of CED with a p value of 0.01 (23). In addition, the research is also in line with the research results, namely that there is a significant relationship between carbohydrate intake and the incidence of chronic energy deficiency in adolescents in Pekon Pasir Ukir. (2). In the field conditions during the research, the results of the food recall showed that almost 70% of the intake needs of female students were met from carbohydrate sources. The sources of carbohydrates that are often consumed are rice, instant noodles, and flour. If someone experiences a lack of carbohydrate intake for a long time, it will cause weight loss and muscle tissue damage (23). If carbohydrate sources are sufficient, there will be no breakdown of muscle or fat reserves, so there will be no chronic energy deficiency.

Fat intake also showed a significant relationship with CED, with p-values of 0.04 in urban areas and 0.018 in rural areas, and OR values of 4.08 and 3.14, respectively. Female students with inadequate fat intake have a risk of 4.08 and 3.14 times greater of experiencing CED than female students with sufficient fat intake. This finding is consistent with research conducted among high school students in Pekon Pamenang, which reported a significant relationship between fat intake and CED (p =0.001). Conversely, a study at SMAN 1 Bergas, Semarang City, found no association between fat intake between mid-upper arm circumference(p=0.144) (24). Inadequate fat intake may contribute to insufficient energy intake, because fat provides the highest energy density among macronutrients. Dietary recall data indicated that the primary sources of fat among participants were cooking and fried snacks, such as chips and fritters. Fried foods were also commonly consumed as side dishes. Excessive fat intake is stored as adipose tissue and can be mobilized as an energy source when energy or protein intake is inadequate (25).

CONCLUSION AND RECOMMENDATION

Energy, protein, carbohydrate and fat intake are direct causal factors of CED in high schools in

urban and rural areas of Kediri Regency. Geographically, the areas are different, but nutrient intake remains the cause of CED in female students even though the available food and access to food are also different. Therefore, education is needed about daily food intake needs so that students know the needs so they do not experience Chronic Energy Deficiency (CED). Deficiency intake if it occurs continuously can cause many impacts in the short and long term..

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