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The Relationship Between Energy, Protein, and Iron Intake Levels with the Incidence of Chronic Energy Deficiency (CED) in Class VIII Students at SMP Negeri 5 Surabaya

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ABSTRACT
Adolescents need energy, protein, and iron, for growth and development. Lack of energy will lead to reduced protein and fat which serve as alternative energy sources. Protein deficiency can affect food transport, resulting in reduced muscle mass. Iron deficiency can cause CED due to its effect on haemoglobin synthesis. The purpose of the study was to determine the relationship between the level of energy, protein, and iron intake with the incidence of CED in class VIII students at SMP Negeri 5 Surabaya. Materials and Methods using analytical observational cross sectional technique with 57 respondents. Data collection technique was random sampling. The study was conducted for 5 months. Data were collected through interviews and measurements of upper arm circumference. The results of the study students with CED category (68.4%). The highest level of energy intake was very low category (71.9%). The highest level of protein intake was very low category (70.2%). The highest level of iron intake was severe deficit category (98.2%). Conclusion there is a significant relationship between energy and protein intake with incidence of CED ($p = 0.000$ $\alpha < 0.05$) and there is no relationship between iron intake with incidence of CED ($p = 0.143$ $\alpha > 0.05$).

Keywords: Energy Intake, Protein Intake, Iron Intake, Incidence of CED

BACKGROUND
Chronic Energy Deficiency is still a concern in Indonesia. Chronic Energy Deficiency occurs when an individual suffers from chronic malnutrition, which can negatively affect their health. Women can check or measure their Upper Arm Circumference to help assess the risk of Chronic Energy Deficiency(Supariasa, Bakri, and Fajar 2016). If energy intake is inadequate, fat reserves in the body will be utilised. If fat reserves are utilised continuously, proteins found in the liver and muscles will be converted into energy. This will lead to muscle mass depletion, as indicated by an upper arm circumference <23.5 cm. Consequently, CED is the result of persistently low energy intake(Dictara, Angraini, and K 2020). On the other hand, a continuous lack of protein intake can cause symptoms such as decreased immunity, susceptibility to disease, and decreased performance. Protein deficiency can also disrupt nutrient transport, meaning that muscle mass becomes smaller(Morrissey, Beall, and Ellacott 2021). Surabaya City has the highest number of motorised vehicles in East Java. As the number of motorised vehicles increases, so does the air pollution caused by their exhaust emissions(Khairina 2019). Increased COHb levels can reduce cellular oxygen uptake ability, thereby lowering human blood pressure(Wijanarko and Lestari 2022). And when the body is deficient in iron, it can lead to Chronic Energy Deficiency (CED) due to its impact on haemoglobin production. When the body is deficient in iron, the body's haemoglobin production is disrupted, so the body has to work harder to meet its oxygen

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needs(Telisa and Eliza 2020). So, CED occurs when the individual suffers from chronic malnutrition, which can have a negative impact on their health(Prihatini, Lindayani, and Surati 2021). If a woman experiences CED and is not intervened quickly, the condition can be dangerous well into the pregnancy and result in a low birth weight baby(Hamalding, Oka, and Ika 2023).

According to WHO data, a large proportion of the population of African and Asian countries, especially in Sub-Saharan Africa and Southeast Asia, make up the main epicentre of global poverty and Chronic Energy Deficiency. There were 815 million cases of CED in 2018 compared to 777 million in 2015, and at least 120 million women (60%) in South and Southeast Asia are estimated to suffer from Chronic Energy Deficiency (CED)(WHO 2018). According to Basic Health Research data (2018), the national prevalence of CED among non-pregnant women was 14.5%. In 2018, the prevalence of non-pregnant women in East Java was 13.88%. Indonesia has 36.3% risk of CED among non-pregnant women aged 15-19 years. East Java province, meanwhile, has a 37.73% risk of CED among non-pregnant women aged 15-19 years(Kemenkes RI 2018b). According to provincial statistics on the incidence of CED in Surabaya City, Surabaya is one of 39 districts or cities with an incidence rate of CED risk in non-pregnant women that is greater than the provincial average, which is more than 13.88%(Kemenkes RI 2018a). Based on the description of problems, the researcher chose this location to be used as a research site. Then the results of preliminary studies that have been carried out by measuring the upper arm circumference of 15 Class VIII students, out of 15 students who suffer from CED as many as 11 students (73.3%) while 4 students (26.6%) do not suffer from CED. Based on these problems, researchers have an interest in conducting research on the Relationship Between the Level of Intake of Energy, Protein, Iron with the Incidence of Chronic Energy Deficiency (CED) in Class VIII Students at SMP Negeri 5 Surabaya.

This study is an analytical observational study with a cross-sectional design(Sugiyono 2018) The research was conducted at SMP Negeri 5 Surabaya and was conducted from October 2023 to April 2024. The population in this study were class VIII students at SMP Negeri 5 Surabaya, totalling 130 students. The sample in this study amounted to 57 respondents, which were taken by using simple random sampling technique using random numbers in excel application. In this study, to collect data involved a 2x24 hour recall interview and anthropometric measurements, namely upper arm circumference and using univariate and bivariate analysis using the spearman correlation test to see the relationship between variables(Notoatmodjo 2019).

RESULTS

Table 1. Characteristics of Respondents by Age at SMP Negeri 5 Surabaya

Age	n	%
13	7	12.3
14	40	70.2
15	10	17.5
Total	**57**	**100**

According to table 1 above, the respondents in this study were 13 years old with 7 students (12.3%), 14 years old with 40 students (70.2%), and 15 years old with 10 students (17.5%).

Table 2. Frequency Distribution of Energy, Protein, and Iron Intake Levels among Class VIII Students at SMP Negeri 5 Surabaya

Energy Intake Level	n	%
Very Low	41	71.9
Low	7	12.3

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Energy Intake Level	n	%
Normal	8	14.0
Over	1	1.8
Total	**57**	**100**
Protein Intake Level	**n**	**%**
Very Low	40	70.2
Low	5	8.8
Normal	10	17.5
Over	2	3.5
Total	**57**	**100**
Iron Intake Level	**n**	**%**
Severe Deficit	56	98.2
Moderate Deficit	1	1.8
Mild Deficit	0	0
Normal	0	0
Over	0	0
Total	**57**	**100**

According to table 2 above, the majority of students have a very low level of energy intake, namely 41 female students (71.9%). The majority of students have protein intake in the very low category, namely a total of 40 students (70.2%). And the majority of students have iron intake in the severe deficit category, namely a total of 56 students (98.2%).

Table 3. Frequency Distribution of Chronic Energy Deficiency (CED) among Class VIII Students at SMP Negeri 5 Surabaya

Category	n	%
CED	39	68.4
Not CED	18	31.6
Total	**57**	**100**

According to table 3 above, it can be seen that the number of Chronic Energy Deficiency incidents at SMPN 5 Surabaya in class VIII students who are categorised as Chronic Energy Deficiency using upper arm circumference measurements <23.5 cm is 39 students (68.4%). While class VIII students who are categorised as not Chronic Energy Deficiency are 18 students (31.6%).

Table 4. Cross Tabulation of the Relationship between Energy Intake Level and the Incidence of Chronic Energy Deficiency (CED) in Class VIII Students at SMP Negeri 5 Surabaya

Energy Intake Level	Incidence of CED in Class VIII				Total		P- Value
	CED		Not CED				
	n	%	n	%	n	%	
Very Low	34	59.7	7	12.2	41	72.0	0.000
Low	2	3.5	5	8.8	7	12.2	
Normal	3	5.2	5	8.8	8	14.0	
Over	0	0	1	1.8	1	1.8	
Total	**39**	**68.4**	**18**	**31.6**	**57**	**100**	

Spearman correlation test showed a significant relationship with a p-value of 0.000. With a p-value smaller than α (0.05), H0 was rejected and H1 was accepted,

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indicating a relationship between energy intake and the incidence of CED.

Table 5. Cross Tabulation of the Relationship between Protein Intake Level and the Incidence of Chronic Energy Deficiency (CED) in Class VIII Students at SMP Negeri 5 Surabaya

Protein Intake Level	Incidence of CED in Class VIII				Total		P- Value
	CED		Not CED				
	n	%	n	%	n	%	
Very Low	33	57.9	7	12.3	40	70.2	0.000
Low	2	3.5	3	5.3	5	8.8	
Normal	4	7.0	6	10.5	10	17.5	
Over	0	0	2	3.5	2	3.5	
Total	**39**	**68.4**	**18**	**31.6**	**57**	**100**	

Spearman correlation test showed a significant relationship with a p-value of 0.000. The p-value is smaller than α (0.05) H0 is rejected and H1 is accepted indicating a relationship between protein intake and the incidence of CED.

Table 6. Cross Tabulation of the Relationship between Iron Intake Level and the Incidence of Chronic Energy Deficiency (CED) in Class VIII Students at SMP Negeri 5 Surabaya

Iron Intake Level	Incidence of CED in Class VIII				Total		P- Value
	CED		Not CED				
	n	%	n	%	n	%	
Severe Deficit	39	68.4	17	29.8	56	98.2	0.143
Moderate Deficit	0	0	1	1,8	1	1.8	
Mild Deficit	0	0	0	0	0	0	
Normal	0	0	0	0	0	0	
Over	0	0	0	0	0	0	
Total	39	68.4	18	31.6	57	100	

Spearman correlation test showed a significant relationship with a p-value of 0.143. The p-value is more than α (0.05) H0 is accepted and H1 is rejected indicating no relationship between iron intake and the incidence of CED.

DISCUSSION

Characteristics of Respondents by Age at SMP Negeri 5 Surabaya

After the study, there were 7 respondents aged 13 years (12.3%), 40 respondents aged 14 years (70.2%), and 10 respondents aged 15 years (17.5%). Adolescent nutrition intake is very important during this developmental period. Adolescent girls have a tendency to experience malnutrition, especially Chronic Energy Deficiency (CED)(Sandala, Maureen I. Punuh, and Sanggelorang 2022). To support the body's metabolism, adolescents must consume the right amount of food for their needs(Herawati 2023). According to the results of the study, respondents who ate less had a desire to look smaller or slimmer. As a result, individuals prefer to focus on their body image, at this age adolescents are more concerned with their physical image including limiting food consumption or following a wrong diet(Manoppo and Lang 2022).

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Level of Energy Intake in Class VIII Students at SMP Negeri 5 Surabaya

Based on the results of the study, the majority of respondents had the highest level of energy intake, namely in the very low category, namely 41 students (71.9%). The energy intake of most respondents was very low due to several factors, namely often skipping or eating breakfast, improper eating habits, and inappropriate eating habits(Oematan, Oematan, and Mege 2023). Respondents prefer snacks to meals and skip breakfast, even though breakfast is the best source of energy for the brain to concentrate at school. All living things need energy to perform their various tasks. If the amount of energy obtained is less than the amount used, stored energy from muscle or adipose tissue will be utilised to make up the shortfall(Putri Yuniarsih 2021). There are three main factors that determine eating habits, frequency, type and amount. As a result, an improper diet can jeopardise a person's nutritional status(Kawatu 2022).

Level of Protein Intake in Class VIII Students at SMP Negeri 5 Surabaya

Based on the results of the study, the majority of respondents had the highest level of protein intake, namely in the very low category, namely a total of 40 students (70.2%). The protein consumption of the respondents was in the very less category. According to the results of the 2x24 hour recall interview of the respondents, the results of protein consumption were less diverse and in smaller quantities. Other protein-rich food sources can be obtained from fish, which is rarely consumed by respondents. Fish is a healthy and protein-rich food(Andhikawati et al. 2021). Fish is high in protein and contains essential amino acids that the body needs. These essential amino acids cannot be made by the body itself and must be obtained from other sources(Nurapipah and Lestari 2023).

Level of Iron Intake in Class VIII Students at SMP Negeri 5 Surabaya

Based on the results of the study, the majority of respondents had the highest level of iron intake in the severe deficit category, namely 56 students (98.2%). All respondents experienced iron deficiency due to not consuming enough iron-rich foods. Many respondents did not consume fruits with vitamin C content which is important for iron absorption. This lack of vitamin C consumption adds to iron deficiency because a diverse diet increases red blood cell production and iron absorption. As a result, dietary variation acts as an indirect signal of low vitamin consumption in adolescents, potentially increasing susceptibility to anaemia and other nutritional deficiencies(Amha and Girum 2018).

Relationship between Energy Intake Level and Chronic Energy Deficiency (CED) in Class VIII Students at SMP Negeri 5 Surabaya

The results of the Spearman correlation test showed a p-value of (0.000). If the p-value is smaller than α (0.05), then H0 is rejected, which means there is a relationship between energy intake and the incidence of CED in class VIII students at SMP Negeri 5 Surabaya. Insufficient energy intake can cause Chronic Energy Deficiency (CED), because the body does not get enough energy needed to fulfil functional needs and daily activities. Another cause of CED is the unavailability of sufficient fuel for the body to do its job(Fakhriyah et al. 2022). Insufficient calorie intake leads to a drop-in body temperature. The body converts stored fat into energy. If the body continues to consume stored fat as energy until it runs out, it will convert protein stored in the liver and muscles into energy. If protein reserves are depleted regularly, muscle mass will be lost, which can result in Chronic Energy Deficiency(Aguillard et al. 2022).

Relationship between Protein Intake Level and Chronic Energy Deficiency

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(CED) in Class VIII Students at SMP Negeri 5 Surabaya

The results of the Spearman correlation test showed a p-value of (0.000). If the p-value is smaller than α (0.05), then H0 is rejected, which means there is a relationship between protein intake and the incidence of CED in class VIII students at SMP Negeri 5 Surabaya. Protein has a unique function of building and maintaining body cells and tissues so that protein cannot be replaced by other substances. Lack of continuous intake of protein nutrients will cause symptoms such as decreased endurance, susceptibility to disease, and increased risk of death(AA et al. 2020). In Chronic Energy Deficiency caused by a lack of protein intake, the body lacks the materials to repair and maintain these tissues. When protein intake is low, the body tends to utilise existing energy reserves, including fats and carbohydrates, to fulfil its energy needs. If protein intake continues to be deficient, then these energy reserves can also be depleted, resulting in Chronic Energy Deficiency (CED)(Izzati and Mutalazimah 2022).

Relationship between Iron Intake Level and Chronic Energy Deficiency (CED) in Class VIII Students at SMP Negeri 5 Surabaya

Based on research conducted on Class VIII students at SMP Negeri 5 Surabaya, the results of the Spearman correlation test obtained a p-value of 0.143. This shows that the p-value is more than α (0.05), so H0 is accepted, meaning that there is no relationship between the level of iron intake and the nutritional status of CED in Class VIII students at SMP Negeri 5 Surabaya. This condition illustrates how iron consumption is only one of the many variables that determine the occurrence of CED(Lina, Arbaiyah, and Meliani Sukmadewi Harahap 2022).Therefore, iron consumption is not the only major factor determining the prevalence or incidence of CED. Another cause of insufficient iron intake in adolescent girls is the frequent consumption of non-heme iron sources and substances that inhibit iron absorption. The difference in absorption efficiency between heme and non-heme iron has a major impact on iron levels. Heme iron is easily absorbed by specialised transporters in the cell membrane. Whereas non-heme iron must be converted to heme iron in the body before it can be properly absorbed. In addition, inhibitors such as caffeine and tannins in coffee and tea significantly limit the absorption of non-heme iron(Young et al. 2018).

CONCLUSION

The characteristics of grade VIII students at SMPN 5 Surabaya based on age were mostly 14 years old, as many as 40 respondents (70.2%). The highest level of energy intake category was very low, with 41 respondents (71.9%). The highest level of pro-tein intake was very low, with 40 respondents (70.2%). The highest level of iron in-take was in the severe deficit category, with 56 respondents (98.2%). The incidence of Chronic Energy Deficiency (CED) in class VIII female students at SMPN 5 Surabaya was highest with 39 respondents (68.4%) experiencing CED. The Spearman correla-tion test found a significant association between energy intake and CED incidence ($p = 0.000$, $\alpha < 0.05$). Protein intake was shown to be significantly associated with the occurrence of CED ($p = 0.000$, $\alpha < 0.05$). Iron intake did not significantly correlate with CED incidence ($p = 0.143$, $\alpha > 0.05$).

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