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Hemoglobin Levels and Nutrients Intake on Young Soccer Athletes in Yogyakarta

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Abstract

The purpose of this study was to know the relationship of nutrients intake and hemoglobin levels in young soccer athletes. This research was an analytical descriptive research with cross-sectional approach. The subjects were 30 athletes of U-13 and U-14 who are active member of SSB Real Madrid UNY. Subjects were measured hemoglobin level using Easy Touch tool. Intake of nutrients were obtained using Semi Quantitative Food Frequency (SQFFQ) form. Data were analyzed using statistical software. Data were processed using chi-square test and pearson correlation. Hemoglobin level in young soccer athletes of SSB Real Madrid was 14.29 ± 2.16 kg/m2 (normal). Energy intake was poor as many as 15 people (50%), good intake as many as 15 people (50%). Protein intake was good as many as 4 people (13%), poor intake as many as 26 people (87%). Fat intake was poor as many as 18 people (60%), good intake as many as 12 people (40%). Iron intake of 11 people (36.7%) were in poor category, 19 people (63.3%) were normal category. Vitamin C intake as much as 6 people (20%) had poor category, and 24 people (80%) had normal category. There was no significant relationship of energy, protein, fat and iron intake with hemoglobin status ($p>0.05$). However, there was a significant relationship of carbohydrates and vitamin C intake with hemoglobin levels in athletes ($p<0.05$). There is no relationship of energy, protein, fat and iron intake with hemoglobin levels. But, there is a relationship of carbohydrates and vitamin C intake with hemoglobin levels of young soccer athletes.

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INTRODUCTION

Soccer is a sport games that require agility, skill, and speed. Thus, athlete performance is needed during exercise (Irawan, 2007). The technical, tactical, physical, psychological, and physiological abilities of athletes greatly affect the performance of athletes (Stolen et al., 2005). Afriani et al. (2015), explains that quality of sleep and anxiety also greatly affect the performance of athletes.

The prevalence of iron deficiency anemia in girls and men adolescence in range 13-18 years old each of 18.5% and 22.7% (Kemenkes RI, 2013a). Nurhaedah et al. (2013) showed that hemoglobin status in soccer athletes from the Anyelir Soccer School as much as 46.7% people of anemia, while the Bangau Putra Soccer School which suffer anemia is 47.6%. According to Beard and Tobin (2000), groups which vulnerable to exposure the low levels of iron status in their blood are female athletes, long-distance runners, and athletes who choose to become vegetarians. Thus, the incidence of anemia in athletes is very vulnerable. Unbalanced nutrients also support the occurrence of anemia in athletes.

Anemia is a common health problem in developing countries, especially in adolescence. According Soekirman (2000), anemia can lead to lack of oxygen in the body so easy to experience fatigue, and the performance becomes decreased. The values of VO2 max are strongly influenced by blood volume and Hb levels which are essential for transporting oxygen in the blood (Wiarto, 2013).

An athlete needs more oxygen to produce the calories that used during exercise and competition. Hemoglobin is needed by the body to transport oxygen. In the formation of Hb, the body requires iron from meat, green vegetables and legumes (Depkes RI, 2002; Almatsier 2009).

Anemia is influenced by various factors i.e. lack of nutrient intake, lack of iron absorption, increased nutritional needs, and increased iron expenditure caused by abnormality. In addition, poor diet of adolescents are susceptible to anemia. Consumption of processed foods that are poor of vitamins and minerals in teenage children being susceptible to anemia and decreasing performance (Adriani, and Wirjatmadi, 2013; Arisman, 2002). Penggalih and Huriyati (2007) added that soccer athletes have a habit of consuming tea almost every day with an average consumption of 1.75 glasses/day. While the average frequency of eating 3 times/day with low the quality of food intake.

Therefore, this study aims to determine the relationship of nutrients intake with hemoglobin levels on young soccer athletes.

METHODS

Design, place, and time

The design of this study was descriptive analytic. Subject were measured the hemoglobin level, nutrient intake, and nutritional status. This research had been done at SSB(School Soccer) Real Madrid UNY in April - September 2017. The subjects of this study were 30 people of young athletes of SSB Real Madrid UNY people who are the active member on U-13 and U-14 and done the participation during the research.

Data Collection

Subjects were measured the body weght, height, calf circumferences, trisep, arm circumferences, and nutritional status through Body Mass Index (BMI). Nutritional status were determined based on WHO-Asia Pasific Criteria. Data of nutrient intake was obtained through interview using SQFFQ form. Hemoglobin levels were measured using hemoglobin examination kit.

Categorization of Hb levels based on WHO data, while intake based on the adequacy of athletes calculated based on age, weight, height and physical activity. Energy formula: (17.5 x BB (kg) + 658.2) x PA (Williams, 2007). While the categorization of iron and vitamin C intake using hypothetical average. However, the categories used in data analysis are combined into two categories: poor and good. Poor category is a combination of the low and excess categories.

Data collection instruments including informed consent form, subject characteristics form, Semi Quantitative of Food Frequency (SQFFQ), digital scales, microtoise, skinfold caliper, and hemoglobin checking kit.

This research was approved by Health Research Ethics Commission, Faculty of Health Sciences, Universitas Respati Yogyakarta with number 610.4/FIKES/PL/VI/2017. Prior to establishing the subject of study, each subject will be asked for their willingness by signing informed consent. All research data will be guaranteed confidentiality.

Data Analysis

Data were analyzed descriptively using statistical software. Data were tested for normality using saphiro wilk test. Data were analyzed univariate to show the frequency and percentage of hemoglobin levels, nutrients intake, and nutri-

tional status of athlete (mean±SD). In addition, data were analyzed bivariatally using chi-square test. Data were also analyzed using pearson correlation to see the relationship between variables ($p<0.05$).

RESULTS AND DISCUSSION

The performance of athletes is influenced by various factors, including dietary intake, nutritional status, and Hb levels of athletes. The high prevalence of iron nutritional anemia in adolescents with range 13-18 years is considerable concern especially in adolescent athletes (Kemenkes RI, 2013a).

Table 1. Subject Characteristics

Characteristic	n (%)	Mean ± SD
Age (year)	30 (100%)	13 (11-15)*
Body Weight (kg)	30 (100%)	43.8 ± 12.39
Height (cm)	30 (100%)	153.80(134.25-170.00)*
BMI for age	30 (100%)	-0,03 (-3,76-2,54)*
Calf circumferences (cm)	30 (100%)	31.68 ± 3.517
Tricep (mm)	30 (100%)	6.00 (2.00-20.30)*
Arm circumferences (cm)	30 (100%)	22.48 ± 3.294

*Median (Minimum-Maximum)

Table 1. showed that the average of age of soccer athletes SSB Real Madrid is 13.16 ± 1.21 years old, with four soccer athletes has fat category, one soccer athletes has very thin category and 25 soccer athelets has normal category of BMI-for-age indicator . A good nutritional status is required for soccer athlete performance. This is in line with the research of Penggalih et al. (2016), which indicates that the average of BMI score in soccer athletes is normal category.

According to Silvestre et al. (2006), 60% of weight gain is affected by increased of body composition. Increased of body composition is showed from the increased of muscle tissue can improved strength and performance of athletes.

Based on the measurement of hemoglobin level, the average of hemoglobin measurement in SSB Real Madrid students is 14.29 ± 2.16 g/dl which include the normal category. However, when viewed from the category of Hb levels based on age, as many as 5 people (16.67%) have low Hb levels. Normal Hb levels in athletes are needed to support performance. Total blood volume and hemoglobin increased during very important exercise used to transport oxygen strongly associated with VO2 max (Katch et al., 2011).

Table 2. Hemoglobin Levels on Young Soccer Athlete

Variables	n (%)	Mean ± SD
Hemoglobin levels	30 (100%)	14.29 ± 2.16

Based on **Table 2.** it showed that the result of hemoglobin measurement on soccer athletes is 14.29 ± 2.16 gr/dl. Hemoglobin levels for adolescent between12-14 years old is 12 gr/dl, however the levels of hemoglobin for above of 14 years old is 13 gr/dl (Arisman, 2002). Table 3. showed the nutrients intake of soccer athletes at SSB Real Madrid Yogyakarta based on interviews using SQFFQ.

Table 3. Nutrients Intake on Young Soccer Athletes

Variables	n (%)	mean±SD
Energy (kcal)	30 (100)	2171.10 (1430.30-2877.70)*
Protein (gr)	30 (100)	89.85 ± 30.65
Fat (gr)	30 (100)	49.32 ± 19.47
Carbohydrate (gr)	30 (100)	362.62 ± 79.06
Iron (mg)	30 (100)	16.30 (5.90-43.00)*
Vitamin C (mg)	30 (100)	189.45 (9.90-668.70)*

*Median (Minimum-Maximum)

The intake of energy, proteins, fat, carbohydrate, iron and vitamin C included the normal category, but intake of protein athletes are excessive (186%) (**Table 3**). The calculation of macronutrient athlete requirements was calculated based on the BMR formula using the average weight of the athlete. The adequacy of iron intake as much as 15-18 mg/day. The adequacy of vitamin C intake for athletes as much as 200 mg/day (Kemenkes RI, 2014). Meanwhile, according to (Kemenkes RI, 2013b), the adequacy of adolescents for vitamin C is 75 mg/day.

Based on **Figure 1.** it can be seen that the description of energy intake in athletes in poor category as many as 15 people (50%), good intake as many as 15 people (50%). Description of protein intake in athletes in good category as many as 4 people (13%), and poor intake as many as 26 people (87%). Description of fat intake in athletes in the category of poor as many as 18 people (60%), good intake as many as 12 people (40%). Description of carbohydrate intake in athletes in the category poor as much as 12 people (40%), while good intake as many as 18 people (60%).

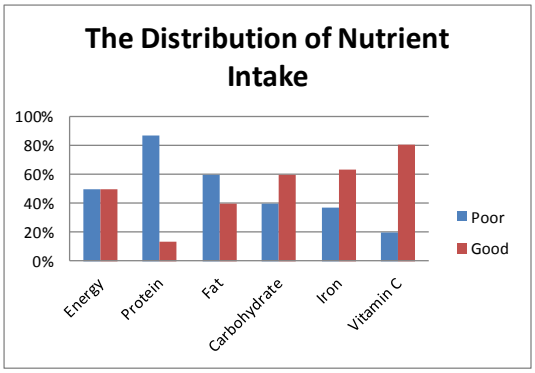

Figure 1. The Distribution of Nutrient Intake

Penggalih et al. (2016) explained that the average intake of macronutrient on soccer athletes is good. While in this study found intake of excess protein athletes. Adequate intake is needed to support athlete's performance. Protein intake in this study is excessive. This is supported by the habit of eating from proteins sources has more than the adequacy in a day. According to the Kemenkes RI (2014), the adequacey of protein ranged from 1.2 gram/kg body weight.

Micronutrient intake on athletes which measured are iron and vitamin C. Iron intake of 11 people (36.7%) were in poor category, 19 people (63.3%) were normal category. While, vitamin C intake as much as 6 people (20%) has poor category, and 24 people (80%) has normal category (**Figure 1**.).

Adequate nutrition intake support the formation of hemoglobin in the body. Hb levels are influenced by various factors, namely vitamin C and protein as a binder of iron in the blood and abnormal conditions in the body (Guyton and Hall, 2008). Maughan (2014) adds that the heart's ability to distribute oxygen in the blood to the muscles becomes a decisive factor in producing optimal VO2 max capacity.

Table 4. Correlation between nutrient intake and hemoglobin levels on young soccer athletes

Variables	Hemoglobin Levels		Total	P value
	Poor (n)	Good (n)		
Energy				
Poor	2	13	15	0.651
Good	4	11	15	
Total	6	24	30	
Protein				
Poor	6	20	26	0.557
Good	0	4	4	
Total	6	24	30	
Fat				
Poor	4	14	18	1.00
Good	2	10	12	
Total	6	24	30	
Carbohy-drate				
Poor	3	9	12	0.013*)
Good	3	15	18	
Total	6	24	30	
Iron				
Poor	0	11	11	0.061
Good	6	13	19	
Total	6	24	30	
Vitamin C				
Poor	3	3	6	0.048*)
Good	3	21	24	
Total	6	24	30	

*)significant = p<0.05, #Chi square (table 2x3) ##Fisher exact test, ###Pearson correlation

A good nutritional intake is required for athletes during exercise and competition. According to Guyton & Hall (2008), muscle performance in athletes depends on the nutrients that support muscle performance ie the levels of glycogen stored in the muscles before exercise or compete. Athletes given a high intake of complex carbohydrates will have more glycogen stores in the muscles to support performance. **Table 4.** showed a significant correlation between carbohydrate intake and Hb levels in athletes using pearson correlation test (p=0.013) with low of coefficient correlation (r=0.449).

However, in this study there were no significant differences in energy intake, protein, fat and iron (p>0.05) (**Table 4**). The other research explain that macronutrient intake did not have a significant relationship in blood biochemistry i.e hemoglobin levels (p>0.05) (Penggalih et al., 2017).

Although protein intake in athletes is high, it does not have a significant effect on Hb levels in athletes (p>0.05) (**Table 4**). Type of protein intake greatly affect the increase in Hb levels. Some athletes often consume a vegetable source of nuts that include phytate, which are also inhibit the absorption of iron. According to Lee (2011), intake of various nutrients can reduce the occurrence of nutritional deficiency. This is also illustrated in a study conducted by Pramartha (2010), which shows that there is no significant difference in mean of hemoglobin between vegetarian and non-vegetarian group in women. Nugroho et al.,

(2015) also explained that there was a significant relationship between non heme-protein intake and the incidence of anemia (p=0.002). Women who consumed enough non-heme protein, did not have anemia. Thus, the intake of non-heme protein contributes to reduce the incidence of anemia.

In this research, subjects who have low levels of hemoglobin have less of vitamin C intake (66.67%). Moreover, athletes is never taking vitamin C supplements. In addition, protein intake of athletes is also in the category of poor as much as 100%. However, inversely proportional of iron intake of athletes is good, as much as 18.52 grams/day. Based on the recommendation of AKG for 13-15 years old, the adequacy of iron as much as 19 mg/day. While the intake of iron for athletes based on Kemenkes RI (2014) as much as 15-18 mg/day. Iron is a heme and non heme. If the intake of iron is sufficient, but not accompanied by a good enhancer, then the intake of iron can not be transferred into the blood properly. Iron metabolism in the body requires protein and vitamin C as an enhancer (Almatsier, 2009). Vitamin C is used to reduce Fe^{3+} to Fe^{2+} in the small intestine. Iron absorption increases four times if non-heme intake is consumed along with vitamin C. In addition, vitamin C can transport iron from ferritin in plasma to ferritin liver (Keith, 2006).

Anschuetz et al. (2010) explained that the serum ferritin levels in the medium-high iron availability (MHIA) in the runners were greater than the serum ferritin in the low-medium iron availability (LMIA). In addition, increasing serum ferritin levels is not only from iron intake, but also on more enhancers for non-hem sources, animal proteins and vitamin C. Furthermore, Cendari et al. (2011), showed that iron, zinc, copper, folate, and vitamin B12 intake has a relationship with hemoglobin levels on women.

In addition, based on interviews using SQFFQ, subjects who have low levels of hemoglobin consuming tea every day. As many as 100% of athletes consumed a glass of tea after meal time. Some athletes consume a glass of coffee 2-3 days/week. Other studies suggest that tea consumption is associated with a decrease in serum ferritin in the body. However, it did not correlate significantly with subjects who had normal Hb levels (Pynaert et al., 2009).

Soccer athletes have risk factors for iron depletion. High prevalence of hemolysis (71%) in the soccer athletes was found, none of the subjects had anemia. Two soccer athletes who had iron depletion should exercise lowered and increased the iron intake (Noda et al., 2009). Fujii et al. (2015) explained that some males athletes did not meet the RDA of iron, but this was not reflected by low levels of hemoglobin. Concentrations of hemoglobin were normal in all participants. However, there are some reported cases in which the serum ferritin level was low despite a normal Hb concentration. According to Irdilla et al. (2016), energy intake, protein intake, fat intake, carbohydrate intake, vitamin B6, and Fe have a significant relationship with cardiorespiratory endurance athletes. Therefore, proper dietary regulation is needed for an athlete to support the performance.

CONCLUSION

There was no significant difference in energy, protein, fat, and iron intake. However, there was significant differences in carbohydrate and vitamin C intake on young soccer athletes. Consumption of athletes should consider the source of enhancer and inhibitors of iron absorption from daily intake. The further reasearch needs the measurement of serum ferritin of athletes. It is necessary to educate of young soccer athletes and athlete's parents about the guide of consuming the balanced diet and selection of food sources to support performance of athletes.

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