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Kualitas Diet, Status Gizi, dan Hemoglobin antara Atlet Remaja Putri Endurance dan Non Endurance Sports

Diet Quality, Nutritional Status, and Hemoglobin Levels among Endurance and Non Endurance Sports Female Adolescent Athletes

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ABSTRAK

Latar belakang: *Berdasarkan durasi dan intensitas latihan, olahraga dibedakan menjadi dua yaitu endurance dan non endurance (strength dan power). Olahraga endurance beresiko lebih tinggi memiliki kualitas diet dan kadar hemoglobin yang rendah, indeks massa tubuh (IMT) dan persen lemak tubuh yang kurang.*

Tujuan:*Penelitian bertujuan mengetahui perbedaan kualitas diet, persen lemak tubuh, dan kadar hemoglobin antara atlet remaja putri endurance dan non endurance.*

Metode: *Penelitian observasional dengan cross-sectional design, melibatkan subjek sebanyak 23 atlet olahraga endurance dan 21 atlet olahraga non endurance di BPPLOP Provinsi Jawa Tengah, klub renang dan atletik Unnes, dan klub atletik Salatiga. Subjek dipilih dengan metode purposive sampling. Persen lemak tubuh diukur dengan alat Bioelectrical Impedance Analysis merk tanita DC-360. Kadar hemoglobin dianalisis menggunakan metode cyanmethemoglobin. Kualitas diet dinilai dari formulir semi quantitative food frequency questionare (SQ-FFQ) dan diet- quality index-international (DQI-I). Analisis data yang digunakan yaitu uji independent t-test dan Mann-Whitney.*

Hasil: *Sebagian besar atlet endurance dan non endurance memiliki status gizi menurut persen lemak tubuh kategori normal. Sebanyak 9,5% atlet non endurance mengalami anemia. Ada perbedaan kualitas diet (p=0,029) dan sub komponen variasi protein, asupan besi, vitamin C, serta makanan rendah zat gizi (p<0,001; p=0,028; p=0,045; p<0,001) antara atlet remaja putri endurance dan non endurance. Tidak terdapat perbedaan persen lemak tubuh (p=0,573), dan kadar hemoglobin (p=0,741).*

Kesimpulan: *Terdapat perbedaan kualitas diet, sub komponen variasi protein, asupan besi, vitamin C, dan makanan empty calory (rendah zat gizi) antara atlet endurance dan non endurance.*

Kata Kunci: *Kualitas Diet; Lemak Tubuh; Kadar Hemoglobin; Atlet; Remaja Putri*

ABSTRACT

Background: Based on the level of intensity, sport defines into endurance and non-endurance sport Athlete of Endurance sports is a high risk sport with low diet quality, nutritional status (body mass index (BMI) and body fat percentage), and haemoglobin level.

Objectives: The aimed of this study is to analyze the differences of diet quality, nutritionl status, and haemoglobin level of female adolescent athletes in endurance and non endurance sports.

Methods: An observational study with a cross-sectional design was conducted on 23 endurance athletes and 21 non endurance athletes in BBLOP Central Java, UNNES swimming and athletic sports club, and Salatiga atlhetic sports club. Subjects were selected by purposive sampling. Body Fat Percentage was measured by Bioelectrical Impedance Analysis (Tanita DC-360). Haemoglobin level was assessed by cyanmethemoglobin method. Diet quality was measured by semi quantitative food frequency questionnaire (SQ-FFQ) and diet quality index-international (DQI-I) form. Data was analyzed by independent t-test and Mann-Whitney.

Results: Mostly, endurance and non endurance athletes have normal nutritional status based on percentage of body fat. About 9,5% of non endurance athlete had anemia. There were significant difference in diet quality (p=0.029) and variety of protein source, iron, vitamin C, and empty calorie foods intake (p<0.001; p=0.028; p=0.045; p<0.001) of endurance and non endurance athletes, but no significant difference in body fat percentage (p=0.573) and haemoglobin level (p=0.714).

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Conclusion: There were significant difference on diet quality, variety of protein source, iron, vitamin C, and empty calorie foods intake between endurance and non endurance athletes.

Keywords: Athletes, Body Fat, Diet Quality, Female Adolescents, Haemoglobin Levels

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INTRODUCTION

Adolescence is a period that lasts between the ages of 11-21 years which is marked by rapid growth and development on the physical, psychological, emotional, social, and intellectual aspects. The rapid growth and physical development influence the changes in eating behavior such as the application of an inappropriate diet that caused adolescent nutritional problems.[1] One of the youth groups in Indonesia that is prone to experiencing nutritional problems is adolescent female athletes. Based on the Level of Intensity, sport defines into endurance and non-endurance sport.[2]

Endurance exercise is a type of exercise with a duration of 30 minutes to 4 hours depending on the capacity of the aerobic system in providing energy for the body. Examples of sports that include endurance sports are long-distance running, middle and long-distance swimming, rowing.[2,3] Strength sports (non-endurance) are sports with muscle strength that usually last for a short duration and depend on the phosphagen system and anaerobic glycolysis. Examples of strength sports include bodybuilding, weightlifting, wrestling, gymnastics, sprinting, long jumping, and boxing.[2–4]

Fulfillment of nutrients in athletes must meet nutritional needs in terms of quantity and quality. Assessment of diet quality in adolescent athletes can be used as an important source of information to see dietary variation, fulfillment, and adequacy of micro and macronutrients.[5] Research in Kentucky, United States states that female athletes have an average diet quality score of 53 which indicates a low diet quality, with less than needed intake of iron, fruits, vegetables, and sodium and calcium intake that exceeds the need. [6]

The eating habits of different athletes in each sport affect the quality of the diet.[6] Large energy and carbohydrate intakes are usually needed by athletes in endurance sports to maintain muscle glycogen reserves and optimize sports performance, due to the high intensity of exercise and long training duration. The eating habits of different athletes in each sport affect the quality of the diet.[2] However, young female athletes are a group that is at risk of having a low-quality diet so that they have insufficient carbohydrate and energy intake.[7] Research in São Paulo, Brazil showed low diet quality in female soccer athletes by 54 out of a total score of 100 where athletes needed to increase their intake of fruit (47%), vegetables (64%), seeds (100%), milk and their products (61%), and fish (80%), but athletes also need to reduce their saturated fat intake by 31% and sodium by 61%.[8] Non-endurance athletes, namely strength sports such as weightlifting and bodybuilding, require high calorie and protein needs to optimize the availability of energy which functions to support muscle growth.[2,9]

Body composition is related to sports performance which encourages athletes to adjust their eating and exercise habits to reduce body fat and increase the proportion of muscle mass.[10] Research states that athletes have varying body fat in various sports.[11] In non-endurance sports, a good body composition is needed because this sport is competed based on the weight category, where low body fat mass affects the speed and strength of the athlete. However, research in Riau Province conducted in 2015 found that most (more than 50%) of weight lifters, weight lifters, and bodybuilding athletes were obese based on their body fat percentage.[12] Endurance athletes have low body fat percentage.[13] Research in Serbia showed running athletes (9.2%) had a lower body fat percentage than handball athletes (13.8%).[14]

Another nutritional problem experienced by young female athletes with high exercise intensity and menstrual cycles is anemia.[2] Anemia can affect exercise performance where hemoglobin levels function as a carrier of oxygen from the lungs to the tissues. The body has decreased, causing fatigue and loss of concentration.[15,16] But unfortunately this is not followed by a good diet such as inadequate food intake, and consumption of tea and coffee.[17]

Hemoglobin levels in endurance athletes are lower than in non-endurance sports. Research in Germany in 2002 showed the average hemoglobin level in endurance athletes was 15.8 g / dL, whereas in strength athletes it was 16.3 g / dL, and in combination sports endurance and strength was

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15.9 g / dL..[18] Low hemoglobin levels are more experienced by athletes in endurance sports because endurance sports activities can increase plasma volume leading to fluid retention resulting in a decrease in hemoglobin levels.[18] This increase in plasma volume is intended to compensate for the negative effects caused by exercise (fluid loss through increased capillary permeability, high osmotic pressure in muscles, and sweating).[18]

The risks of health problems that occur in young female athletes include body fat percentages, hemoglobin levels, and low-quality diets, apart from having an impact on athlete's performance but also causing intergenerational malnutrition problems. Young women with malnutrition and anemia have a higher risk of experiencing health problems during the pregnancy period and the 1000 HPK (First Day of Life) period, and can increase the risk of giving birth to babies who have low birth weight (LBW).[19]

Until now, there are not many studies that analyze the quality of diet, anemia, and nutritional status of female athletes in endurance and non-endurance sports. Based on this background explanation, researchers are very interested in finding out how the differences in nutritional status based on body fat percent, hemoglobin levels, and diet quality among young female athletes in endurance and non-endurance sports at the Central Java Province Student Center for Education and Sport Training (BPPLOP), swimming clubs and Semarang State University athletics, and the Salatiga athletic club.

METHODS

The research sites were on the Center for Student Sports Education and Training Center (BPPLOP), Central Java Province, Semarang State University's swimming and athletic club, and the Salatiga athletic club in May-June 2019. This research was an observational study using a cross-sectional design. The sample size was determined based on the sample size formula for the two independent groups, namely: n = [ZαxS / d] 2. This research was started by screening 87 subjects, then 44 subjects (23 endurance athletes and 21 non-endurance) athletes were selected based on the inclusion criteria using a purposive sampling technique. Endurance athletes were from rowing, swimming, medium distance running, and marathon sport, while non-endurance athletes were from weightlifting, boxing, judo, fencing, and athletics sports. Inclusion criteria were not on a weight loss diet or due to certain diseases, had experienced menstruation and were not menstruation, did not smoke, did not experience worm infections, and were willing to fill out form of willingness to be the subject of research. The exclusion criteria in this study were the subject was absent or sick throughout the study. This research has received permission from the Health Research Ethics Commission, Faculty of Medicine, Undip No.280/EC/KEPK/FK UNDIP/VII/2019

Table 1. Description of research subjects based on age, nutritional status, hemoglobin levels and diet quality

Subject Characteristics	Mean±DS	Median	Minimum	maximum
Age (years)	17.4±2.3	17	13	21
Body Weight (kg)	55,2±8.8	53.5	41.4	87.6
Height (cm)	157.9±5.4	158	145	167.8
Body fat percentage (%)	26.4±6.8	25.2	17.2	49.8
Hemoglobin level (g/dL)	13.6±1.2	13.7	11.4	17.3
Diet Quality (skor DQI-I)	55.9±8.5	57	37	73

*BMI= Body mass index
DS= Deviation Standard

The dependent variables of this research were diet quality, body fat percentage, and hemoglobin levels. Meanwhile, the independent variables were endurance sport (long distance running, medium and long distance swimming, rowing, and cycling)[2,3] and non-endurance sports (weightlifting, wrestling, gymnastics, running 100 m (sprint), long jump, and boxing).[2–4]

Body fat percentage is the total mass of fat divided by total body mass which measured using the Bioelectrical Impedance Analysis (BIA) brand of Tanita DC-360. Body fat percentage categorized as underfat if ≤15%, normal if 16-29%, overfat if 30-34%, and obesity if> 35%.[20]

Diet quality is a food consumption assessment based on the Nutrient Adequacy Ratio (NAR) and General Guidelines for Balanced Nutrition which is assessed using the Diet Quality Index-International (DQI-I) form. Dietary quality was measured with food intake assessment using the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) form. We got the results based on the diet quality score. After obtaining the scores for each component (variation, adequacy, moderation, and overall balance) then added up, so that the variation in the total score scores in DQI-I ranges from 0 to 100 (0 is the lowest score and 100 is the highest score). Dietary quality categorized as low if ≤

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60% and high if > 60%.[21–23]. Hemoglobin Level is a protein in your red blood cells to determine anemia status. Hemoglobin Level measured using cyanmethemoglobin method. Hemoglobin Level categorized as normal if ≥12 mg/dL and low (indicate anemia) if <12 mg/dL.[24 25]

The results of this study were presented in a frequency distribution table, numeric data in the form of maximum values and maximum minimum values, mean and standard deviation. The presentation of categorical data was in the form of percentages. Bivariate analysis was used to determine differences in diet quality, body fat percentages, and hemoglobin levels between female athletes in endurance sports and non-endurance sports. The variables of diet quality and hemoglobin levels were normally distributed, so that they used the independent t-test. The variables of BMI and body fat percent were tested using Mann Whitney because the data were not normally distributed. All data analysis using *software Statistical Package for the Social Sciences* SPSS versi 21.

RESULTS AND DISCUSSION

The result of body fat percentage measurement showed that 73.9% of endurance athletes and 66.7% of non-endurance athletes had normal body fat percentages. There were 14.3% (n = 3) of the obese category were found in non-endurance sports (weightlifting athlete and 2 javelin throw athletes). This study found 17.4% endurance sport (swimming athletes) and 19% non-endurance sport (weightlifting 3 athletes and boxing athlete) categories as overfat. It meant non-endurance athletes (mean =27.02 ± 7.5) has a higher body fat percentage than endurance athletes (mean =25.8 ± 6.2). Study in Turkey 2016 found that weight lifters (non-endurance sport) have greater body fat than swimming athletes (endurance sport).[26] Body fat percentage in swimming athletes is higher than other athletes in endurance sports (medium distance running, long-distance running, and rowing). These results were in line with research in Brazil 2017 which showed female swimming athletes has a higher body fat percentage than other athletes such as running, gymnastics, and rowing since these sports require more movement.[27] Endurance exercise with high-intensity exercise can increase basal metabolism in body cells, it facilitates the mobilization and oxidation of fat, especially in visceral adipose tissue which decrease the body fat percentage. Besides that, the rate of fat oxidation is also depend on the length of duration exercise.[28]

9.5% of the non-endurance athletes (sprinting and hurdling athlete) experienced anemia. This result was higher than endurance athletes that had no subjects with anemia. The result showed that there was no significant difference (p = 0.741) in hemoglobin levels between endurance and non-endurance athletes. It has the same result with a study in Japan 2015 that stated there were no difference in hemoglobin levels in various sports.[24] The other studies showed different results that non-endurance athletes (judo), have high hemoglobin levels compared to endurance athletes (running medium and long distances).[24,29] Anemia that occurs both on endurance and non-endurance athletes in this study can be caused by iron intake that less than the recommended requirement.[24]

Table 2. Profile of Nutritional Status and Anemia Status of The Subjects.

Characteristics	*Endurance* (n=23)		*Non endurance* (n=21)	
	n	%	n	%
Age				
12-18 years	10	43,5	18	85,7
19-21 years	13	56,5	3	14,3
Body fat percentage (%)				
Underfat	0	0	0	0
Normal	17	73,9	14	66,7
Overfat	4	17,4	4	19
Obese	2	8,7	3	14,3
Anemia status				
Anemia	0	0	2	9,5
Normal	23	100	19	90,5

Mostly both endurance and non-endurance athletes had low diet quality. It was found that endurance athletes had higher diet quality than non-endurance athletes around 43.5%. There was also a significant difference in diet quality scores between endurance and non-endurance sports (p = 0.029). The average of diet quality in endurance athletes was higher (58.61 ± 7.96) than the non-endurance athletes (53.05 ± 8.36). However, the diet quality in both groups was still low because the diet quality scores in both groups were ≤60. As many as 56.6% of endurance athletes and 71.4% of non-endurance athletes had low diet quality. This happens because of the mismatch intake of nutrients contained in the components of the diet quality. The low diet quality in the endurance sports athletes was mainly due to the excess of some of the sub-components in the moderation component, the lack of some nutrients in the adequacy component, and the low overall balance. Meanwhile, in the non-endurance sports group, the components that cause

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the low quality of the diet were insufficiency and low overall balance score.

Based on diet quality components data, there were no significant differences in all components of variation, adequacy, moderation, and overall balance between endurance and non-endurance athletes (p = 0.113; p = 0.075; p = 0.819; p = 0.322). The data on the mean of the adequancy score showed that most of the subjects in both groups had not met the daily intake recommendations, especially the intake of fiber, iron, and calcium in both groups was low because it did not meet the total Nutrient Adequacy Ratio (NAR) in 2013.[25] Meanwhile, the overall balance component showed that the ratio of macronutrients and the ratio of fatty acids were still low. This illustrated the imbalance of a daily diet, where the subject has an unbalanced proportion of energy sources and fatty acid composition. Intake of subjects tended to have eating habits with a high proportion of fats from the needs and higher saturated fats than monounsaturated and polyunsaturated fats. Meanwhile, the moderation scores in both groups were included in the low criteria. Based on Table 3, the high percentage of subjects in the endurance and non-endurance groups who have excess intake of saturated fat, cholesterol, and low nutrient foods indicated that the subjects prefer foods with low nutrient density and high fat. However, the endurance group had a lower mean moderate score than the non-endurance group, where the mean intake of sodium, cholesterol, and low-nutrient foods in the endurance group was higher. These results were consistent with research in Lithuania in 2015 which showed endurance sports athletes had saturated fat and cholesterol intake that exceeded the recommended needs.[7] The final component in assessing diet quality is overall balance. The mean overall balance score in both groups was similarly low, with the mean of the non-endurance group was lower than the endurance group.

Table 3. Profile of Subjects Diet Quality

Variable	Component	*Endurance*		*Non endurance*	
		n	%	n	%
Diet Quality	Low	13	56,6	15	71,4
	High	10	43,5	6	28,6
Adequacy					
Vegetables (portion/day)	High (≥3-5)	5	21,7	1	4,8
	Medium (1,5-2,9)	6	26,1	2	9,5
	Low (<1,5)	12	52,2	18	85,7
Fruits (portion/day)	High (≥2-3)	21	91,3	14	66,7
	Medium (1-1,9)	0	0	4	19
	Low (<1)	2	8,7	3	14,3
staple food group (portion/day)	High (≥3-8)	16	69,6	11	52,4
	Medium (1,5-2,9)	6	26,1	9	42,9
	Low (<1,5)	1	4,3	1	4,8
Fiber adequacy (g/day)	High (≥20-30)	8	34,8	4	19
	Medium (10-19)	9	39,1	7	33,3
	Low (<10)	6	26,1	10	47,5
Protein adequacy (% energy/day)	High (≥15)	5	21,7	4	19
	Medium (8-14)	14	60,9	13	61,9
	Low (<8)	4	17,4	4	19
Iron adequacy (% NAR/day)	High (≥100)	4	17,4	2	9,5
	Medium (50-99)	7	30,4	3	14,3
	Low (<50)	12	52,2	16	76,2
Calcium adequacy (% NAR/day)	High (≥100)	4	17,4	2	9,5
	Medium (50-99)	10	43,5	8	38,1
	Low (<50)	9	39,1	11	52,4
Vitamin C adequacy (% NAR/day)	High (≥100)	16	69,6	9	42,9
	Medium (50-99)	3	13	7	33,3
	Low (<50)	4	17,4	5	23,8
Moderation					
Total fat (% total energy/day)	High (≤30)	14	60,9	13	61,9
	High (>30)	9	39,1	8	38,1
Saturated fat (% total energy/day)	Low (≤10)	7	30,4	7	33,3
	High (>10)	16	69,6	14	66,7
Cholesterol (mg/day)	Low (≤300)	11	47,8	8	38,1
	High (>300)	12	52,2	13	61,9

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Variable	Component	*Endurance*		*Non endurance*	
		n	%	n	%
Natrium (mg/day)	Low (≤2400)	20	87	20	95,2
	High (>2400)	3	13	1	4,8
Low nutrient foods	Low (≤10)	2	8,7	6	28,6
(% total energy /day)	High (>10)	21	91,3	15	71,4
Overall Balance					
Macronutrients ratio	High (6)	0	0	0	0
	Medium (4)	2	8,7	0	0
	Low (0-2)	21	91,3	21	100
Fatty acid ratio	High (4)	0	0	0	0
	Medium (2)	0	0	0	0
	Low (0)	23	100	21	100

Several sub-components, such as variations in protein sources, iron intake, vitamin C, foods low in nutrients and carbohydrates, found that there was a significant difference between the endurance group and the non-endurance group (p = 0.000; p = 0.028; p = 0.045; p = 0.000; p. = 0.023). The result of the food variation score in the endurance group was higher (18.09 ± 2.42) than the non-endurance group (17 ± 2.32). Although the score of variation in the endurance group was higher, the protein source of sub-component in the non-endurance group showed a higher mean result than the endurance group. The non-endurance sports athletes consume more sources of animal protein (meat and poultry) ≥2-3 servings/day. Meanwhile, most endurance athletes did not eat meat. The low consumption of meat in the endurance athletes group because most of the endurance groups did not live in the dormitories so that athletes did not have good eating arrangements in terms of type, amount, and time of eating. These results were the same as research at PPLOP Central Java in 2019 which showed protein intake of non-boarding athletes were lower than boarding athletes.[30] In the endurance and non-endurance groups, adequate protein intake is very important. The need of protein for non-endurance athletes is higher than for endurance athletes because adequate protein intake can increase muscle size and strength.[31]

Table 4. Nutritional status (BMT dan Body fat percentage), hemoglobin level, and diet quality differences of *endurance* and *non-endurance* athletes

Category (score range/point)	*Endurance* (n=23) Mean±DS	*Non endurance* (n=21) Mean±DS	*p*
BMI (kg/m^2)	21,7±2,9	22,6±3,6	0,518[a]
Body fat percentage (%)	25,8±6,2	27,0±7,5	0,573[a]
Hemoglobin level (g/dL)	13,5±0,9	13,7±1,5	0,741[b]
Diet Quality (score)	58,6±7,9	53,2±8,4	0,029 [b*]
Variation (score)	18,1±2,4	17±2,3	0,113[a]
All food range (food range /day)	4,4±0,8	4±0,7	0,080[a]
Source of protein (range/day)	5±0,6	5,8±0,4	0,000[a*]
Adequacy (score)	26,5±8,3	21,9±7,5	0,075[a]
Vegetable (portion/day)	1,9±2,2	0,9±1,4	0,053[a]
Fruits (portion /day)	6,7±6,6	5,2±5,3	0,366[a]
Whole grain (portion /day)	4,8±2,6	3,4±1,8	0,074[a]
Fiber (g/day)	17,3±10,3	12,6±7,7	0,098[a]
Protein (g/day)	89,4±33,7	92,1±45,8	0,944[a]
Iron (mg/day)	18,1±15,9	11,1±9,8	0,028[a*]
Calcium (g/day)	782,8±464,8	675,8±344,9	0,581[a]
Vitamin C (mg/day)	154,1±126,8	85,8±69,4	0,045[a*]
Moderation (score)	13,6±6,8	14±31,8	0,819[b]
Total fat (g/day)	98,1±43,1	101,1±42,5	0,953[a]
Saturated fat (g/day)	44±17,7	47,9±15,9	0,518[a]
Cholesterol (g/day)	367,6±236,7	348,1±168,7	0,565[a]

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Category (score range/point)	*Endurance* (n=23) Mean±DS	*Non endurance* (n=21) Mean±DS	*p*
Natrium (mg/day)	1585,7±685,2	1283,9±671,3	0,148[b]
Low nutrient foods (kcal/day)	927,5±415,5	475,1±222,7	0,000[b*]
Overall Balance (score)	0,4±1,4	0,1±0,4	0,322[a]
Macronutrients ratio	0,4±1,2	0,1±0,4	0,322[a]
Fatty acid ratio	0	0	1,000[a]
PUFA[1] (g/day)	12,9±6,3	13,9±8,9	0,833[a]
MUFA[2] (g/day)	24,9±11,5	46,7±110,8	0,778[a]
Carbohydrate (g/day)	335,7±113,4	260±110,9	0,023[a*]
Total energy (Kcal/day)	2588±786,1	2301±881,4	0,162[a]

Keterangan: [a]Mann Whitney, [b]Independent T-test,[*]Signifikan (p>0,05), [1]PUFA=Polyunsaturated fatty acid, [2]MUFA=monounsaturated fatty acid

Protein is a macronutrient that functions as a source of essential amino acids in the body. As much as 80% of the total free amino acids in the body are in muscle tissue. In muscle tissue, amino acids undergo oxidation to produce ATP so that it is sufficient to meet energy needs.[32] In non-endurance sports, an increase in muscle mass or hypertrophy is required. Higher protein intake in endurance sports athletes affects positive protein balance where there is an increase in protein synthesis beyond protein breakdown. Increased protein synthesis results in muscle hypertrophy which then affects muscle strength in non-endurance sports. An increase in muscle mass or hypertrophy is required. Higher protein intake in endurance sports athletes affects positive protein balance where there is an increase in protein synthesis beyond protein breakdown. Increased protein synthesis results in muscle hypertrophy which then affects muscle strength.[2,33] Research on non-endurance athletes in Indonesia in 2014 showed that there was a positive correlation between protein intake and muscle strength.[34] Whereas in endurance sports with a long training duration, protein plays an important role in the recovery process by rebuilding muscle through breakdown of old or damaged proteins and re-synthesizing protein.[35]

There was a significant difference of iron intake in the two groups (p <0.05). The data showed that non-endurance athletes had a lower adequacy level compared to endurance athletes. This is because 76.2% of athletes cannot meet the recommended amount of iron intake. Besides that, iron intake plays a role in energy metabolism for endurance sports. Energy metabolism in endurance sports depend on the aerobic system which requires oxygen to produce energy. Hemoglobin is a protein molecule that contains iron and myoglobin in muscles. Hemoglobin in the blood functions as an oxygen carrier from the lungs to be given to all body tissues. Meanwhile, myoglobin plays a role in receiving, storing, and releasing the oxygen into muscle cells.[36] These result were inline with research in Japan which showed athletes in endurance and non-endurance sports have an iron intake that was less than the recommended requirement, but sprinting athletes who are one example of non-endurance sports have a lower average iron intake than middle-distance athletes and long-distance.[24]

Adequacy of vitamin C for athletes for endurance and non-endurance groups were classified as good. Mean intake of vitamin C for athletes of endurance sports were higher than non-endurance athletes. The high adequacy of vitamin C in the endurence sports was related to the high adequacy of good fruit (91.3%). Research in India in 2009 showed the same results. Athletes in endurance sports had a higher intake of vitamin C than athletes in non-endurance sports.[37] Vitamin C is a micronutrient that acts as an antioxidant that can reduce reactive oxygen and nitrogen. Antioxidants are substances that contribute to relieving the effects of stress and oxygen deprivation caused by exercise by reducing free radical reactions.[38]

The portion of the consumed grains group showed a higher mean in the endurance sport. This result was in line with the components of carbohydrate intake where there were differences between the two groups. The endurance sports had a higher carbohydrate intake. Carbohydrates serve as the main energy source and stored as glucose polymers, which called glycogen. [39] The insufficient carbohydrate intake can cause feelings of fatigue during exercise and decreased aerobic performance.[7] Meanwhile, research in the United States showed that non-endurance athletes with low carbohydrate intake (<40% of energy intake) are sufficient to improve sports performance. This is because non-endurance sports have a short duration so that carbohydrate needs are also lower than endurance sports.[40] Apart from carbohydrate intake, the sub-component section also showed a significant difference for low nutrient foods between the two groups, where the intake of low-nutrient foods in the endurance sports was higher than non-endurance sports. Most athletes in endurance sports are non-boarding athletes, so it is easier for them to access fast food that is high in energy density but poor in fiber. Apart from fast food, soft drinks are also included in the low-nutrient food group which is mostly consumed by endurance sports athletes.[30]

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The strength of this research is that there are not many studies that have examined the differences in nutritional problems in endurance and non-endurance athletes in Indonesia, but this study also has drawbacks and limitations, namely the variety of sports in each group due to the limited number of subjects in each sport. Besides, it is necessary to study more about the measurement of nutritional status from the biochemical aspect using other biomarkers related to nutritional problems in athletes, not only anemia status based on hemoglobin levels alone.

CONCLUSION

Based on the body fat percentage measurement, 17.4% of endurance sports athletes and 19% of non-endurance athletes are overfated. 9.5% of non-endurance athletes are anemic. Endurance athletes have a higher diet quality (43.5%) than non-endurance athletes (28.6%). There was a difference (p = 0.029) in the quality of diet between female athletes in endurance sports and non-endurance sports, but there was no significant difference in body fat percentages and hemoglobin levels (p = 0.573; p = 0.741). Suggestions for athletes and coaches are the need for education. and counseling on the importance of nutrition for young female athletes regarding the quality of a good diet such as increasing the portion of vegetables, iron intake, and reducing the consumption of fatty foods and low nutrient foods. In addition, further research can use the appropriate diet quality assessment instrument for the athlete population.

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