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Uric Acid and Nutrient Intake of Adolescent Soccer Players in Yogyakarta

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Abstract

The aim of this study was to view uric acid levels and nutrient intake of soccer players. This study examined the uric acid level differences based on nutrient intake of adolescent soccer players. Indeed, nutritional status monitoring is needed to evaluate health status which can contribute to athletes' performance. This was an observational study conducted at SSB Real Madrid in April-September 2017. Subjects involved in this study were 27 active joined U-13 or U-16 in SSB Read Madrid UNY, Yogyakarta. Uric acid data were obtained by measuring peripheral blood sample. Nutrient intake data were obtained by using SQFFQ form. The differences in uric acid levels based on nutritional intake category were tested using ANOVA test. The average of uric acid levels were 6.72±1.21 mg/dl with average protein intake of 87.38±27.41 grams. The average of energy, fat, and carbohydrate intake was 2,189.02±464.87 kcal, 46.92±15.75 grams, and 365.61±82.32 grams. There was no difference in uric acid levels based on energy, protein, fat, and carbohydrates intake (p=0.216; p=0.489; p=0.587; and p=0.845) of adolescent soccer players. The clearance of uric acid, the amount and type of fluid intake, the type of animal protein, and the purine-source food probably contributed to athletes' uric acid levels.

How to Cite

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INTRODUCTION

Exercise is one component that can support athlete performance because exercise can improve technical and tactical skill, also physiological function of athlete (Bangsbo 2003; Valado et al. 2007). Not only does exercise give positive impact, it can induce oxidative stress because of the imbalance between antioxidants in the body and free radical products–a byproduct of aerobic metabolism in muscle (Souza et al. 2005; Valado et al. 2007; Metin et al. 2003a; Metin et al. 2003b; Atashak and Sharafi 2013). Study conducted to student soccer players of Universitas Gadjah Mada showed that after getting training in the form of VO2max measurements using yo-yo intermittent recovery test level 2, the players had high malondialdehyde level–biomarker of oxidative stress as much as 4.32±2,09 μmol/L (Puspaningtyas et al. 2018).

Biochemical assessment in the form of antioxidant measurement is an important effort to maintain oxidative stress induced by exercise. Uric acid is one of biochemical marker of acute oxidative stress. Uric acid can decrease exercise–induced oxidative stress because of its function to react with reactive oxygen species (Waring et al. 2003 and Kandar et al. 2014). Administration of 0.5 gram uric acid in 250 mL lithium carbonate/dextrose could increase uric acid concentrations followed by the increasing of serum antioxidant capacity after high intensity exercise (Waring et al. 2003).

Exercise increase not only oxidative stress condition but also protein degradation in muscle. Protein is a substance needed by athlete inasmuch as it act in protein synthesis, especially skeletal muscle (Hoffman and Falvo 2004; Wu 2016). Exercise can change nitrogen balance which has an effect on muscle growth. If muscle protein breakdown is greater than muscle protein synthesis, there must be a negative muscle protein balance (Tipton and Wolfe 2001). Consequently, athlete must fulfill the protein requirement so that athlete can perform maximally.

Soccer is a sport that involves explosive activity such as jumps, direction changes, speed changes, tackles, jogs, sprints, and kicks. These activities correlates with several neuromuscular and metabolic indicators (Bangsbo 2003). To do these activities, athletes need proper nutrition to optimize phosphocreatine (PCr) utilization and glycolysis system. This process can decrease the muscle PCr level while it can increase the adenosine diphospate (ADP) degradation products likes uric acid (Maughan and Gleeson 2010). Therefore, nutritional intake is needed to optimize athlete's condition.

To the best our knowledge, the study of monitoring athlete condition has ever been done in adults athlete while the study about monitoring biochemical and dietary condition related to exercise in adolescent soccer players has never been done. The aim of this study was to view the uric acid levels average and nutrient intake average, especially protein. This study also examined the uric acid level differences based on nutrient intake of adolescent soccer players.

This study can give information to athelete, coach, and parents about basal condition of athlete. As a results, they can determine whether the athlete need the supplement or not and what type of healthy food choices because previous study conducted by Wijaya and Riyadi (2015) described that all players in soccer take supplement without knowing whether they need it.

METHODS

This was an observational study with cross sectional design that observed uric acid levels and nutrient intake in adolescent soccer players at SSB Real Madrid Universitas Negeri Yogyakarta, Yogyakarta. The study was conducted from April to September 2017.

Population of this study was all adolescent soccer players who joined SSB Real Madrid. Subjects involved in this study were 27 active players in SSB Real Madrid. Purposive sampling method was used in this study to choose subjects who met the criteria, i.e. joined U-13 and U-16 in SSB Real Madrid, at least three months joined in SSB Real Madrid, and willing to participate in the study. Sick or injured players were excluded in this study.

Before the uric acid levels measurements, subjects received weight and height measurements to determine the nutritional status of subjects. Body weight and body height was processed by using WHO AnthroPlus 2007 to determine the nutritional status based on BMI-for-age index. Interpretation of nutritional status refers to Indonesian Ministry of Health (Kementerian Kesehatan RI 2011).

Levels of uric acid were measured before exercise through peripheral blood sampling using easy touch ®GCU (easy touch ®GCU meter, uric acid check strip, puncturer, lancet, and blood uric acid test strips). Measurement of nutrient intake was done using semi-quantitative food frequency questionnaire (SQFFQ) form. The categorization of food intake was done by comparing the food intake to subjects' nutritional needs. The nutrient intake was categorized to be good if it met 80-120% of the requirement.

Health Research Ethics Committee Health Science Faculty Universitas Respati Yogyakarta had reviewed and approved the protocol of this study with number 610.4/FIKES/PL/VI/2017. Written inform consent was obtained from each subject and all data in this study will be guaranteed confidentiality.

Univariate analysis was done by presenting the frequency, mean, and standard deviation of each variable. Bivariate analysis was performed to determine the differences in uric acid levels based on nutrient intake of athletes. The statistic test used was one-way ANOVA, and statistical significance was accepted at 5% significance level ($p<0.05$).

RESULTS AND DISCUSSION

Subjects characteristics studied in this study included age, body weight, body height, nutritional status (BMI-for-age) (**Table 1**). Subjects with BMI-for-age -2 SD to +1 SD are categorized as normal. Subjects with BMI-for-age >+1 SD and BMI-for-age <-2SD are categorized as overweight and thinness respectively. More than 80% of subjects had normal nutritional status.

Table 2 showed the uric acid levels and nutrient intake of the subject. More than 80% of subjects had high uric acid levels. The energy and carbohydrate intake of the subjects was good whereas the protein intake was excessive and the fat intake was classified as less. The average percentage of energy, protein, fat, and carbohydrate intake of subjects was 101.85%; 142.50%; 78.58%; and 107.01%.

Levels of uric acid in subjects with nutritional intake (energy, protein, fat, and carbohydrates) categories less were likely to be higher than uric acid levels in subjects with good and high nutritional intake categories. There was no difference in uric acid levels based on nutritional intake category ($p>0.05$) (**Table 3**).

Table 1. Subjects Characteristics

Characteristics	n (%)	Mean±SD
Age (years)	27 (100)	13 (11–15)*
Weight (kg)	27 (100)	43.53±12.16
Height (cm)	27 (100)	154.5 (134.25–170)*
BMI-for-age	27 (100)	-0.31±1.20
Nutritional status (BMI/U)		
Overweight	3 (11.1)	1.53±0.37
Normal	23 (85.2)	-0.40±0.82
Thinness	1 (3.7)	-3.76

*Median (Minimum–Maximum)

Table 2. Uric Acid Level and Nutrient Intake of Adolescent Soccer Players

Variable	n (%)	Mean±SD
Uric acid (mg/dl)	27 (100)	6.72±1.21
Uric acid category		
High	23 (85.2)	7.05±0.97
Normal	4 (14.8)	4.80±0.35
Nutrient intake		
Energy (kcal)	27 (100)	2,189.02±464.87
Protein (g)	27 (100)	87.38±27.41
Fat (g)	27 (100)	46.92±15.75
Carbohydrate (g)	27 (100)	365.61±82.32
Energy intake		
High	8 (29.6)	2,738.19±82.36
Good	14 (51.9)	2,110.89±258.18
Less	5 (18.5)	1,529.14±85.58
Protein intake		
High	18 (66.67)	101.37±21.35
Good	6 (22.22)	67.30±3.34
Less	3 (11.11)	43.60±4.49
Fat intake		
High	2 (7.4)	79.90±8.20
Good	12 (44.4)	55.85±5.44
Less	13 (48.1)	33.59±7.14
Carbohydrate intake		
High	11 (40.74)	448.48±37.05
Good	13 (48.15)	326.27±31.69
Less	3 (11.11)	232.20±25.97

To monitor athlete condition is important to detect any negative health outcomes induced by training that will be associated with poor performances (Saw et al., 2016). Biochemical assessment in the form of uric acid measurement can give a description about antioxidant condition before subject getting exercise or training. The average of uric acid level of the subjects in this study was 6.72±1.21 mg/dl. It indicated that the average of uric acid was in normal condition.

Uric acid levels probably increase after subjects get exercise or training. Unfortunately, in this study did not assess uric acid levels after exercise. Previous study stated that exercise can lead high serum uric acid (Huang et al., 2010; Morales et al., 2013; Sariri et al., 2013).

Study done to Brazilian Jiu-Jitsu (BJJ) elite and non-elite athlete group described that there was an increase of uric acid between pre- and post-competition. Uric acid level before and after competition in elite athlete was 4.9±0.8 mg/dl and 7.3±1.2 mg/dl, respectively. Meanwhile, the increasing of uric acid level before and after competition in non-elite athlete is lower than the increasing of uric acid level in elite athlete, i.e. (5.1±1.2 mg/dl) before competition and (6.6±1.4 mg/dl) after competition (Brandao, Fernandes, Alves, Fonseca, & Reis, 2014).

High concentration of uric acid in the blood can be correlated and stimulated by the increasing of reactive oxygen species production in the body. The previous study found that the concentration of uric acid increased immediately after exercise test and reached the maximum value one hour after the end of workout. There was a significant increase of allantoin plasma concentration, the oxidative product of uric acid, after the 10-min running activity (Kandar et al., 2014).

Moreover, in this study there were 23 players with high uric acid level, and the remains were normal uric acid level (**Table 2**). The difference of uric acid level in the subjects was probably caused by the difference of uric acid clearance after exercise in the previous day. High uric acid level in the blood is probably caused by the decrease of uric acid clearance through urine production (Huang et al., 2010). Based on interview to the subjects, subjects often consume sugary beverages, tea, and some subjects also consume coffee. In addition, subjects just drink a bottle of mineral water during exercise. Athletes need drinking enough fluids to prevent dehydration and maintain adequate urinary output after taking exercise (Huang et al., 2010).

Another explanation about the difference uric acid level in the subject maybe related to amino acid catabolism difference due to exercise on the previous day. An increase in uric acid was observed post-competition, probably as an amino acid catabolism result due to mechanical stress induced by muscle damage resulting from muscle contraction during exercise. This mechanism related to the accumulation of the degradation products, hypoxanthine, which is the precursor of uric acid (Zhao, Snow, Stathis, Febbraio, & Carey, 2000).

Based on ANOVA test, there were no differences of uric acid level based on nutrient intake (**Table 3**). Previous study stated that there was significant relationship between protein intake and uric acid levels (p=0,001), also fat intake and uric acid levels (p=0,001). On the other hand, this study was similar to other study that mentioned there was no significant relationship between carbohydrate intake and uric acid levels (p=0,259) (Wahyuni et al. 2019).

Table 3. Uric Acid Difference Based on Nutrient Intake

Nutrient Intake	Nutrient Intake Mean±SD	Uric Acid (mg/dL) Mean±SD	p*
Energy intake (kcal)			
High	2,738.19±82.36	6.65 ± 1.25	0.216
Good	2,110.89±258.18	6.45 ± 1.24	
Less	1,529.14±85.58	7.56 ± 0.81	
Protein intake (g)			
High	101.37±21.35	6.71 ± 1.16	0.845
Good	67.30±3.34	6.38 ± 1.47	
Less	43.60±4.49	7.43 ± 1.10	
Fat intake (g)			
High	79.90±8.20	5.85 ± 0.21	0.489
Good	55.85±5.44	6.74 ± 1.17	
Less	33.59±7.14	6.82 ± 1.34	
Carbohydrate intake (g)			
High	448.48±37.05	6.88 ± 1.12	0.587
Good	326.27±31.69	6.58 ± 1.22	
Less	232.20±25.97	6.67 ± 1.89	

*ANOVA test

Almost 50% subjects had high carbohydrate intake, and the carbohydrate intake ranged from 232 grams to 448 grams. Subjects consumed both complex and simple carbohydrate. Complex carbohydrate often consumed by the subjects are rice, instant noodle, bread, potatoes, pasta, and cassava. Some subjects consumed sugary beverages, tea, and also instant coffee as simple carbohydrate choices. This study showed there is no uric acid difference based on carbohydrate intake. This study had limitation because it did not include effect of fiber intake to uric acid level. Dietary fiber can give positif effect to control serum uric acid (Koguchi and Tadokoro 2019).

Two subjects had high fat intake of 79.90 gram because they consumed fried food more often. This study showed there is no uric acid difference based on fat intake. Previous study showed that there was correlation between fat intake and uric acid levels because the excretion of acid can be inhibited by fat. Higher fat intake can increase uric acid levels (Wahyuni et al. 2019).

Meanwhile, more than 50% subjects had high protein intake. Subjects with less protein consumption had higher uric acid level compared with subject with good and high protein intake. Protein is essential nutrient needed by athlete now that amino acids, monomers of proteins, act in protein synthesis in skeletal muscle (Hoffman & Falvo, 2004; Wu, 2016). To promote skeletal-muscle protein accretion, recommendation of protein intake is 1.3 and 1.6 gram protein per kilogram body weight per day for individuals with moderate and intense physical activity, respectively (Wu, 2016). Other references said that protein recommendations for endurance athlete should be between 1.2-1.4 gram per kilogram body weight each day and recommendation of protein for strength or power athlete are between 1.4-1.8 g/kg/day (Hoffman & Falvo, 2004). When people have enough protein intakes, they will have good nitrogen balance in the body, so the biochemical marker will be in normal condition.

In this study, there were no association between protein intake and uric acid level. Study conducted by Choi showed that the total protein intake was not associated with the serum uric acid level in multivariate analysis, but higher levels of meat and seafood consumption are associated with higher uric acid levels. In this study, some players with high uric acid level were known consuming more animal protein (such as meat, poultry, and seafood) compared with players with normal uric acid level. Moreover, some subjects with high uric acid level also consumed purine-source food, such as spinach and bean (Choi et al., 2005).

CONCLUSION

There were no uric acid level differences based on nutrient intake (energy, protein, fat, and carbohydrate) of adolescent soccer players. The clearance of uric acid through urine production, the amount and type of fluid intake, the type of animal protein, and the purine-source food consumed probably contributed to the uric acid levels of athletes. Further study need to be done to measure uric acid level before and after exercise, not just in the beginning of exercise. Also study about the effect of purine-source food to uric acid level of athlete must be explored more considering the lack information about the precise quantity of purines in most food, especially when processes and cooked.

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