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Case Report

The Effect of A-Tocopherol 400 IU on Malondialdehid (MDA) Plasma and Speed Performance in Run 3000 Metres Junior Athlete

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Abstract

Free radicals receive great attention among practitioners because of oxidative reactions that will disrupt the process of muscle metabolism. Vitamin E (α-tocopherol) has an important role in the conversion of free radicals to less reactive forms. Vitamin E supplementation in humans reduces oxidative stress, lipid peroxidation and muscle soreness after exercise so it is considered as anti oxidant and performance booster. We conduct pre and post experimental analytical research design, with 20 subjects of run 3000metres junior athlete was divided in to 2 groups. First group was administered α-tocopherol 400IU once a day, and second group as placebo. As the results, there was a significance decrease of malondialdehyde plasma after treatment (0.37±0.26 Vs 0.96±0.59 µmol / ml) and there was no sigificance difference of speed performance after treatment (1.80+2.86 vs. 2.00+5.23 seconds). In conclusion, α-tocopherol 400IU once a day for 1 month can decrease level of malondialdehyde (MDA) plasma, and there is no relation between α-tocopherol 400IU consumption with speed performance.

Keywords: α-tocopherol, vitamin E, anti oxidant, free radical, MDA

Background

Humans always carry out activities throughout their lives, both with mild, moderate or severe intensity. These physical activities can produce excessive free radical products. In physical activity, most of the free radicals formed are reactive oxygen species (ROS) [1]. Free radicals receive great attention among scientists and clinical practitioners because they are suspected to be the cause of various diseases, including strokes, heart attacks and cancer. Free radicals can damage important molecules in the body, such as proteins and DNA [2]. In muscles, free radicals will cause oxidative reactions that will disrupt the process of muscle metabolism.

The body has a natural defense against damage from free radicals. This component is called an antioxidant. Antioxidants can be produced by the body itself (endogenous), such as glutathione, glutathione peroxidase, Fe-catalase, uric acid, Mn, Cu, Zn-superoxide dismutase (SOD) and can be derived from everyday foods that we consume (exogenous), such as tocopherol and tocotrienols (vitamin E), ascorbic acid (vitamin C), β carotene, Selenium and others [3].

Free radicals are very reactive and quickly turn into other reactive compounds, so free radicals are difficult to measure directly. One indicator used to determine cell membrane damage due to free radicals is to measure levels of Malondialdehyde (MDA). MDA is produced from the reaction of free radicals with polyunsaturated fatty acids found in many cell membranes. Therefore MDA can be used as a marker of cell membrane damage due to free radicals that cause oxidative reactions in muscles [3].

MDA also results from physical activity and sports. Aerobic exercise with moderate to high intensity can produce an increase in MDA levels. 3000 metres run is a medium-distance run sport with aerobic predominance. According to Duffield and Dawson (2003), 3,000 metres run includes 85.9% aerobic and 14.1% anaerobic [4]. Therefore, runner athletes of 3000 metres in distance are vulnerable to an increase in free radicals and the occurrence of oxidative reactions in muscles that can interfere with athlete performance in competition.

The body's ability to neutralize the increase in free radicals is highly dependent on the efficiency of endogenous antioxidants. However, if the amount is inadequate, exogenous antioxidants are needed. Vitamin E is the first line of defense against the peroxidation process of polyunsaturated fatty acids found in phospholipids in cellular and subcellular membranes [5]. Vitamin E has an important role in the conversion of superoxide, hydroxyl and lipid peroxyl radicals to less reactive forms [6]. Vitamin E supplementation in humans reduces oxidative stress, lipid peroxidation and muscle soreness after exercise and prevented the increase of serum malondialdehyde (MDA) [7,8].

Methods

The subjects are 3000 metres runner junior athletes.. A sample of 20 people where divided in to 2 groups, have participated in the study and subjects were taken by simple random sampling. Criteria for subjects in this study are: (1) Age 18-25 years, (2) male (3) not currently suffering from acute and chronic diseases (4) not taking drugs or vitamin supplementation (5) not doing vigorous physical activity within 24 hours before conducting research, (6) informed consent approval.

This research is an experimental analytic study with pre and post test design. Pre test is the measurement of MDA levels before and after run 3,000 metres before administration of α-tocopherol 400 IU and placebo every day for 1 month, and the post test in this study is measuring MDA levels before run and after run 3,000 meters . Calculation of data analysis using SPSS 25 software, Ms. Excel and NATS 2.0 nutrition analysis program.

Results

Physiological Characteristics of Subjects

Measurement of the physiological characteristics of study subjects divided into placebo groups and groups receiving α-tocopherol which included age, systolic blood pressure (mmHg), diastole (mmHg), resting pulse, pulse after 3000 metres of run, weight, height body, fitness level based on 3000 metrerun test time, α-tocopherol intake based on FFQ can be seen in Table 1.

Table 1: Physiological Characteristics of Subjects.

Variabel	Rata-rata dan Simpangan Baku					
	Kelompok Plasebo			Kelompok A-tocopherol		
Usia (tahun)	19,80	±	1,23	20,20	±	0,63
Sistole (mmHg)	121,00	±	5,68	121,10	±	3,14
Diastole (mmHg)	81,00	±	5,68	78,00	±	6,33
Nadi Istirahat(kali/menit)	77,20	±	7,32	74,60	±	6,93
Nadi Setelah Lari 3000 meter (kali/menit)	141,60	±	3,53	141,70	±	3,65
Berat Badan (kg)	62,80	±	5,94	61,90	±	5,36
Tinggi Badan (m)	1,69	±	0,36	1,67	±	0,04
Waktu Tes Lari 3000 meter (detik)	683.90	±	49.28	677.10	±	51.67
A-tocopherol intake-*FFQ* (mg)	10.50	±	0.59	11.11	±	0.72

The results of measurements of plasma Malondialdehyde (MDA) levels before and after run 3000 metres before being given a placebo and α-tocopherol as listed in Table 2. To see the difference in the levels of Malondialdehyde (MDA) before and after run 3000 metres in the group that given α-tocopherol and the control group (placebo), a paired t-test was carried out as listed in table 2. The results showed that the average level of Malondialdehyde (MDA) in the group to be given α-tocopherol and the control group (placebo) after run was higher than before run 3000 metres.

Table 2: Differences in levels of Malondialdehyde (MDA) Plasma Before and After Run 3000 metres Pre Treatment.

Kelompok	Variabel	Rata-rata dan Simpangan Baku			t_{hitung}	p	Keterangan
		X	±	sd			
Plasebo							
	MDA Sebelum Lari	0.64	±	0.48	-4.96	0.001	Bermakna
	MDA Sesudah Lari	1.54	±	0.74			
Vit E							
	MDA Sebelum Lari	0.77	±	0.52	-4.97	0.001	Bermakna
	MDA Sesudah Lari	1.60	±	0.83			

To determine differences ofchanges in the levels of Malondialdehyde (MDA) after run 3000 metres after being given a placebo and α-tocopherol, a paired t-test was carried out as listed in table 3. The results show that in the group given α-tocopherol for a month there was a decrease in changes in Malondialdehyde (MDA) levels, whereas in the placebo group there was no decrease in changes in plasma Malondialdehyde (MDA) levels, as shown in Table 3.

Table 3: Changes in the Level of Malondialdehyde (MDA) Plasma after Run 3000 metres Before and After Treatment.

Kelompok	Variabel	Rata-rata dan Simpangan Baku			t hitung	p	Keterangan
		x	±	sd			
Diberi Plasebo	Perubahan MDA Sebelum Diberi Plasebo	0.90	±	0.57	-0.56	0.589	Tidak Bermakna
	Perubahan MDA Sesudah Diberi Plasebo	0.95	±	.059			
Diberi Vit E	Perubahan MDA Sebelum Diberi Vit E	0.82	±	0.52	2.33	0.045	Bermakna
	Perubahan MDA Sesudah Diberi Vit E	0.37	±	0.26			

To find out the comparison of run speed between the placebo and α-tocopherol groups, a run time of 3000 metres was calculated between the two groups. The results showed that there was no difference between run speed in the control group (placebo) compared with the α-tocopherol group.

To find out the comparison of α-tocopherol intake based on FFQ between the placebo group and α-tocopherol, an unpaired t-test was performed as listed in Table 4. The results showed that there was no significant difference in α-tocopherol intake between the control group (placebo) compared to the α-tocopherol group

Table 4: Comparison of Run Speed Between the Placebo and A-tocopherol Group.

Rata-rata dan Simpangan Baku			Hasil Uji-t tidak berpasangan	
X	±	Sd	*t*	P

Table 5: Comparison of α-tocopherol intake in the placebo group and α-tocopherol.

Kelompok Sampel	Rata-rata dan Simpangan Baku			Hasil Uji-t tidak berpasangan		Keterangan
	X	±	Sd	*t*	p	
Kontrol (Plasebo)	10.50	±	0.59	-2.04	0.056	Tidak Bermakna
α-tocopherol	11.10	±	0.72			

Keterangan: p < 0,05 ==> signifikan (bermakna)

Discussion

The results found that plasma MDA levels after run 3000 metres are higher than before run both in the placebo group and in subjects to be given α-tocopherol (0.64±0.48 *Vs* 1.54±0.74 μmol / ml: 0.77±0 .52 *Vs* 1.60±0.83μmol / ml). An increase in malondialdehyde (MDA) levels after run 3000 metres, caused by increasing oxygen consumption. This is supported by the research of Vitalla et al (2004) said that exercise with high intensity will increase influx O_2 into the muscles up to 100 times compared to at rest. It will increase 4-5% of superoxide radicals in our body [9]. Not all oxygen consumed by cells is reduced completely in which 2-8% of the total oxygen consumed is only partially reduced and leaks at certain stages of the electron transport chain and exits the respiratory pathway. The oxygen molecule must be completely reduced to H_2O by receiving four electrons. If oxygen is only partially reduced, free radicals are formed. If oxygen only accepts two electrons, hydrogen peroxide is formed, and if it only receives one electon, superoxide radicals are formed [10].

Another mechanism for the formation of free radicals in run 3000 meters is incomplete metabolism of purine compounds. When muscles have contraction, the muscle is hypoxic relatively so that purine nucleated compounds only oxidized to the hypoxanthine stage. When relaxation of muscle reoxygenation occurs, hypoxanthine is converted to superoxide radicals which are catalyzed by xanthine oxidase [1,10]. The presence of neutrophils and macrophages in the process of inflammation and cell repair is also a potential source in the formation of free radicals [1].

The results show that there was a significant decrease in changes of plasma Malondialdehyde (MDA) levels after taking α-tocopherol 400IU a day for 1 month compared to placebo (0.37±0.26 Vs 0.96±0.59 μmol/ml). During moderate to high intensity exercise, significance amount of MDA will be formed, where the MDA will start to increase since 10 minutes after exercise and will continue to reaches peak level between second and third day and then decrease to initial level (baseline) on the 7th day after exercise [11,12,13]. The main function of α-tocopherol is as an fat-soluble antioxidant and easily gives hydrogen from the hydroxyl group (OH) in the ring structure to free radicals. When it receives hydrogen ion, free radicals become unreactive. An α-tocopherol works directly against cell membrane peroxidation by inhibiting the action of free radicals both peroxyl and hydroxyl in initiation chain and preventing the formation of propagation chains on the cell membrane by giving electrons so that the free radicals become stable. Thus the more neutralization of free radicals by α-tocopherol occurs, the less the level of cell membrane damage and the less MDA that is formed [14].

When we compared the speed time between the placebo group and A-tocopherol, the results show that there was no difference (1.80+2.86 vs. 2.00+5.23 seconds). When exercise, there are many factors that improve level of athlete. According to Mc Ardle (2001), achievement is determined by 3 factors, such as exercise, physical fitness, and psychological factors. Although the oxidant levels affect biomolecular energy supply, this is not affect performance significantly in a short time, because of other factors that play a role and have influence each other [15].

Conclusion

In conclusion, α-tocopherol 400IU once a day for 1 month decrease level of malondialdehyde (MDA) plasma, and it is should be used for anti oxidants in run 3000 metres athletes. There is no relation between α-tocopherol 400IU consumption with speed performance.

Conflict of Interest

Authors declared there is no conflict of interest in this paper.

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Data Availability

All data used to support the findings of this study are included within the article.

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