Effect of Aerobic Exercise on Selenium Level in Plasma of Students at Universitas Padjadjaran

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Abstract

Moderate and high aerobic exercises are the activities that can induce high oxidant. Demand of endogen and exogen antioxidant for neutralizing oxidant induced by exercise will play important role in maintaining body performance. Microtrace elements, such as selenium, may able to balance high oxidant formation. However, limited research and data have been collected with regards to the exercise and selenium. Therefore, this research was conducted to investigate the effect of aerobic exercise on selenium level in plasma. An analytic study with experimental method of data collection was performed from October -November 2016. 17 male students with the age between 19-25 years old and without medically compromised disease from Universitas Padjadjaran, Jatinangor, were selected as subjects. Blood samples were taken pre- and post-aerobic exercise, *i.e.,* brisk walking with the intensity of 4.5 mi/h. Selenium level in plasma was then examined by enzyme linked immunosorbent assay (ELISA) kit as selenium binding protein (SELENBP1). This study found that 11 (65%) subjects had a decrease in their selenium plasma after exercise (3.1 ± 2.58 ng/ml), 5 (29%) subjects had an increase in their selenium plasma after exercise (2.08 ± 2.8 ng/ml) and 1 (6%) subject had unchanged selenium (SELENBP1) plasma (1.4 ± 1.4 ng/ml) level. Effect of aerobic exercise on selenium level in plasma varied among individuals.

Keywords: aerobic exercise, selenium, young adult

Introduction

Exercise is a type of physical activity consisting of planned, structured and repetitive bodily movement done to improve and/or maintain one or more components of physical fitness.[1] Moderate and high aerobic exercises are the activities which use large muscle group and cause body to use more oxygen and create high oxidant.[2]

Demand of endogen and exogen antioxidant for neutralizing oxidant induced by exercise will play important role in maintaining body performance. Microtrace element is one of the effectors which can play role as an antioxidant in the body. In biochemistry, trace

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elements are referred as a dietary element that is needed in very minute quantity for proper growth, development and physiology of the organism.[3]

Selenium, an essential mineral and micronutrient that constituent enzyme glutathione peroxidase (GPHPx), may able to balance high oxidant formation by removing hydrogen peroxide and other organic hydroperoxide from cell that is caused by oxidative stress during exercise. In its metabolism, selenium is mainly bound to blood lipoprotein and achieve its highest concentration in red blood cell. Variety of method is available to assess the selenium status including measurement of selenium in blood, plasma, serum red blood cell, platelets, hair and nails. Functional test such as blood, plasma or red blood cell glutathione peroxidase are used to assess the selenium status. The advantage of using plasma is that plasma selenium reflects short-term status.[3,4]

However, limited research have been conducted regarding the effect of exercise on selenium, particularly in young adult which is classified in the age of 19–25 years old.[5] Therefore, this study aimed to to investigate the effect of aerobic exercise on selenium level in plasma in young adults.

Methods

This study was conducted using experimental method from October-November 2016. Minimal samples size for this study was calculated using sampling method of analytic study of paired variables. 17 male subjects were selected from batch 2013 of Faculty of Medicine, Universitas Padjadjaran, with inclusion criteria of subjects aged between 19–25 years old and without medically compromised disease. The exclusion criteria were subjects who had sign and symptoms of inflammation process like fever and joints pain, did moderate or heavy physical activity before experiment was conducted, consumed multivitamin or supplement in past few weeks, had thyroid disease like hypothyroidism, took medication for long term like antibiotic and steroid, followed certain diet particularly with protein restriction, was active smoker in last 1 year and disagreed with the experimental procedure. Exclusion criteria were obtained by interviewing the subjects. Counselling was performed to recruit subjects and continued with the distribution of informed consent to the study subjects. Those who signed the informed consent underwent experimental procedure.

Experiment was started by asking the subjects to take a rest for 1 hour prior to pre-exercise blood was taken. It was continued by withdrawing 3ml of blood from median cubital vein from subjects using a disposable syringe and stored in ethylenediamine tetraacetic acid (EDTA) tube. Each EDTA tube was labelled as A01, A02, and respectively for blood samples that were taken before exercise. Then experiment was continued by asking subjects to do vigorous aerobic exercise which was brisk walk on treadmill for 13 minutes (4.5 mi/h = 13 min/mi) with intensity of 4.5mi/h. Subjects were asked to rest for 30 minutes before the post-exercise blood sample was taken. Then it continued with withdrawing another 3ml of blood sample from median cubital vein using disposable syringe and stored in EDTA tube. Each EDTA tube was labelled as B01, B02, and respectively for blood samples that were taken after exercise. Collected blood samples were stored in a cool box and immediately transported to the Laboratory of Clinical Pathology, Dr. Hasan Sadikin General Hospital for analysis. Selenium level was analysed by measuring selenium bonding protein (SELENBP1) in plasma by using Enzyme Linked Immunosorbent Assay

Table 1. Characteristic of Research Subject

	Total		p-value*
	Mean	MSE	
n	17		
Age (years old)	21.9	0.39	
Selenium Plasma in pre ± post exercise (µg/mL)	2.7 ± 2.58	0.5 ± 0.45	0.495

MSE: Minimum Standard Error; *Paired t test, p value < 0.05

(ELISA) kit for SELENBP1 (Cloud-Clone Corp., SEG326Hu, Hoston, AS).

The obtained result was analyzed using Statistical Product and Service Solution (SPSS) 22.0. The value obtained was analyzed by using paired t-test to find the significant to prove the hypothesis in this study. Normal distribution test for collected data was tested by using Kolmogorov-Smirnov test.

This study was approved by the Ethics Committee of the Faculty of Medicine Padjadjaran University with the reference of 823/UN6.C1.3.2/KEPK/PN/2016 and the primary data collection permit application has been made by researcher to the Head of Department of Medical Faculty of Universitas Padjadjaran with the reference of 7940/UN6. C1/PP/2016

Results and Discussion

17 male subjects signed the informed consent and complete the experiment until the end. Characteristics of the subject is shown in table 1. This study found that 65% of the subjects had a decrease in selenium level in plasma after exercise, 29% of subjects had an increase in selenium level after exercise and 6% subjects had unchanged selenium level in plasma before and after exercise (Figure 1).

From Kolmogorov-Smirnov test for data of plasma levels of selenium in the both pre- and post-exercise concluded that the data used in the study satisfy the assumptions of normality. Paired t test was used to identify if there was significant difference in both selenium level in plasma in pre- and post-exercise. The P-value was 0.495. Since it was more than 0.005, it can be concluded that aerobic exercise has no significant effect on

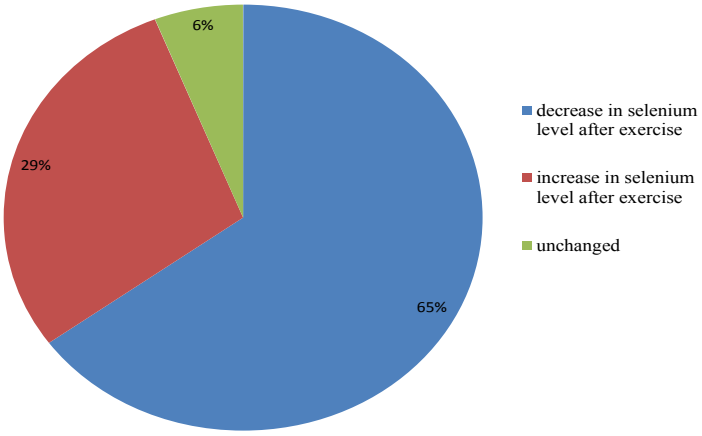

Figure 1. Effect of selenium on plasma on subjects

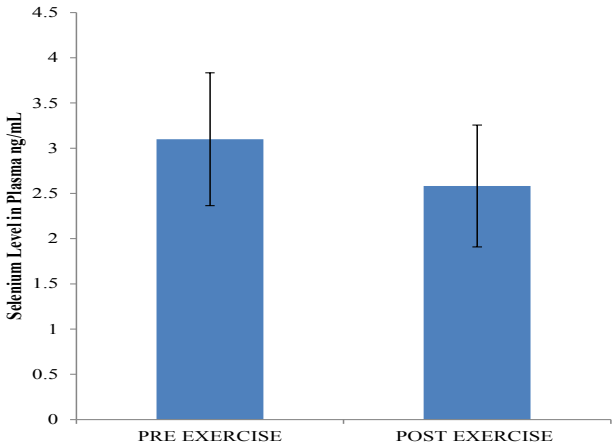

Figure 2. Mean value in group that had decreasing trend of selenium level in plasma

selenium level in plasma (Table 2).

Figure 2 shows the mean value in group that had decreasing trend of selenium level. The mean value of pre-exercise selenium level was 3.10 ng/ml with the minimum standard error of 0.73. At post-exercise, the mean value was 2.58 ng/ml with the minimum standard error of 0.67. Figure 3 shows the mean value in group that had increasing trend of selenium level. The mean value of pre-exercise selenium level was 2.08 ng/ml with the minimum standard error of 0.32. At post-exercise the mean value was 2.8 with the minimum standard error of 0.44. Figure 4 shows the mean value in group that had unchanged selenium level. The mean value in both pre- and post- exercise was 1.4 ng/ml.

According to Dietary Reference Intakes (DRI) developed by the Food and Nutrient Board (FNB) at the Institute of Medicine of the National Academics, the normal value of selenium for young adults is 55mcg.[3] Selenium can be obtained from many food sources, such as beef, fish, nuts, eggs, and bread products.[6,7] Selenium is absorbed mainly in duodenum, caecum and colon and transported from gut mainly to blood lipoprotein and achieves its highest concentration in red blood cell,

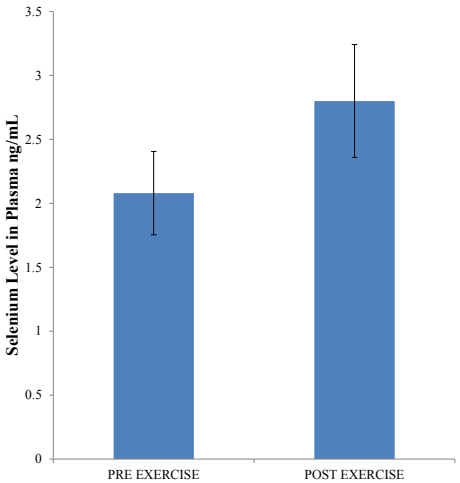

Figure 3. Mean value in group that had increasing trend of selenium level in plasma

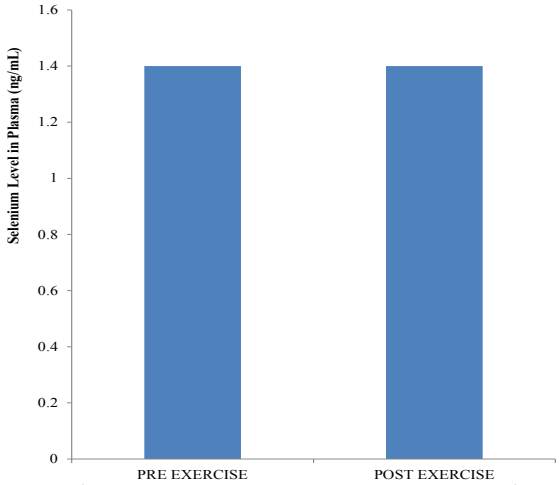

Figure 4. Mean value in group that had unchanged selenium level in plasma

liver, spleen, heart, nails and tooth enamel. The absorbed selenium is excreted through urine with some loss in sweat and skin and small amount though biliary, pancreatic and intestinal secretion.[8,9] Besides being an important nutrient, selenium has been identified as an antioxidant enzyme.[5]

Selenium can be measured by an indirect method, SELENBP1. SELENBP1 has protein coding as gene type which encodes a member of selenium-binding protein family that binds with selenium. SELENBP1 ranges between 0.156 ng/ml to 10 ng/ml.[10] In this study, it has been found that there was trend of decrease in selenium plasma from 3.1 ng/ml to 2.58 ng/ml after aerobic exercise (Figure 2). Theoretically, exercise causes increase in reactive oxygen species (ROS) which is also known as oxidative stress when it is overproduced. Skeletal muscle is known as the origin of ROS. ROS include active molecular oxygen such hydroxyl (HO) and superoxide (O_2) radicals as well as hydrogen peroxide (H_2O_2). Major site of ROS generation in active muscle during exercise are mitochondria, xanthine oxidase, nicotinamide adenine dinucleotide phosphate (NADPH) oxidase, phospholipase A2 dependent processes and some immune cells including macrophage, monocyte, eosinophils and neutrophils.[3,10,11]

Recent studies have indicated that ROS generated during exercise are initiators of two important redox-sensitive signalling pathways, including nuclear factor and mitogen activated protein kinase. Activation of these pathways leads to the induction of antioxidant enzymes including GPHPx, mitochondrial superoxide dismutase (MN SOD), and inducible nitric oxide synthase. Hence, overproduction of ROS and oxidative stress, have led to the development of oxidation of cellular macromolecule such as lipid, protein and deoxyribonucleic acid (DNA) which could lead to the pathogenesis of various degenerative and chronic disease.[3,12]

Therefore, to overcome the oxidative stress problem during exercise, selenium plays its role as an antioxidant by behaving as a co-factor for antioxidant GPHPx, which is responsible for removing H_20_2 from the cell.[3] Selenium metabolism could change during exercise. This is a type of acute phase response. In human, lactate concentration

increase in response to increasing exercise. GPHPx, as a selenoprotein, bound more in endothelial cell in acidosis. Therefore, the decrease in selenium level in the post exercise may be associated with the transfer of lactate from muscle to blood during exercise.[13]

On the other hand, we observed an increasing trend of selenium plasma from 2.08 ng/ml to 2.8 ng/ml after aerobic exercise. Exercise training may introduce additional factors inducing adaptive responses of antioxidant system components. The hierarchy of selenium incorporation into selenoproteins and distribution in tissues can be suspected to be different in each subject. Priority for selenium metabolism and in consequence, the repartition of selenium into tissues for selenoproteins synthesis, may be different in subjects under oxidative stress exposure. It caused several subjects had increased selenium plasma after aerobic exercise.[14]

There was an unchanged selenium plasma trend observed (1.4 ng/ml). There were conflicting reports about the relation between selenium and exercise. It was reported in a study that a 10-week endurance exercise and daily supplementation of 180µg organic selenium did not have any impact on adaptations stimulated by endurance training. A similar finding was observed by Tessier and colleagues. Likewise, it was claimed that aerobic exercise caused DNA damage and selenium supplementation could not hinder this damage. This proves why there were certain subjects who had unchanged selenium plasma before and after aerobic exercise.[15]

Different findings in this study might be resulted from several factors that can alter the selenium level in the body. It is expected that selenium level is affected by dietary factors and supplement use. Food sources like beef and bread products are recognized as good source of selenium and bioavailability of selenium from these food is relatively high.[12] Besides that, content of selenium in food varies widely throughout the world. Plants acquire selenium from the soil and its content varies depends upon the region they are grown. The statement that dietary factors causes alteration in selenium level was proved in a study done by Driskell and colleagues where dietary selenium levels fed to animals were varied which might account in part for the lack of continuity in the result of acute exercise and training effect on activity level of GPHPx and indicator of oxidative damage to tissue. One consistent finding was that animal which had defficient selenium intake had lower tissue levels of GPHPx when compared with animal that had sufficient selenium intake.[15]

Notably, several other demographic and lifestyle factors were independent determinants of selenium levels, including smoking, alcohol intake, age, genetic and sex. Previous studies reported conflicting results in terms of whether oxidative stress level was higher in men or women. The reason for this discrepancy in relationship between sex, selenium and oxidative stress status are unknown.[15-17]

Liability in this study might be resulted from recall bias by subjects, limited period of time and kit to test selenium plasma, and the absence of the control group. Besides, selenium nutritional factors and muscle mass that could interfere with the result were not monitored in this study. For further studies in the area of selenium and exercise, it is suggested to measure the muscle mass and monitor the food intake so that the data analysis can show more consistent results.

Conclusion

The effect of aerobic exercise on selenium

plasma could vary among individuals based on both dietary factors, such as food that contain selenium and supplements made up of selenium, and non-dietary factors, such as demographic factors, lifestyle and adaptive response of the subjects. The results obtained from this study may benefit theoretically for health care professional as the infomation on the influence of aerobic exercise in selenium. Practically, this study may increase the alertness among health care professionals to provide an appropriate exercise to the patients.

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