academicJournals

Vol. 8(12), pp. 844-848, 23 June, 2013
DOI: 10.5897/ERR2013.1165
ISSN 1990-3839 ©2013 Academic Journals
http://www.academicjournals.org/ERR

Educational Research and Reviews

Full Length Research Paper

Comparison of total antioxidant capacity oxidative stress and blood lipoprotein parameters in volleyball players and sedentary

Ismail GOKHAN

Harran University, School of Physical Education and Sports, Sanliurfa-Turkey.

Accepted 8 May, 2013

This study aims to measure, then compare sedentary blood lipoproteins, oxidant- antioxidant state and oxidative stress index in volleyball players. The experimental group of the research consists of regularly practising 20 boys between the ages of 12 and 17, and the control group comprises 32 children practising no particular sports branch, 12 of which are the same age and gender. In order to measure blood lipoproteins and oxidant-antioxidants, venous blood samples are taken into EDTA tubes. Total Antioxidant Capacity (TAC) is determined using a method developed by Erel (Erel, 2004). Lipid hydroperoxide (LOOH) levels are measured using xylenol and Fe^{2+} (Arab and Steghens, 2004). Total Oxidant Status (TOS) is determined by a colorimetric method developed by Erel (Erel, 2004). Oxidative Stress Index (OSI) is calculated using the formula Total Oxidative Stress (TOS) /Total Antioxidant Capacity (TAC) (Erel, 2004). Plasma triglyceride, total cholesterol, LDL, HDL and VLDL parameters are measured using commercial kits (abbot) in automatic chemistry analyzer (Aeroset, Abbott, USA). It is found that there is no statistically significant difference between the groups of anthropometric parameters of subjects of control and experimental groups, as well as between lipoproteins, Plasma triglyceride, total cholesterol, LDL, HDL and VLDL ($p>0.05$), and that the statistical difference between the groups of TAC, TOS, LOOHs and OSI parameters was significant ($p<0.05$). Lipoproteins and oxidative stress parameters did not present any significant relation ($p>0.05$). It is concluded that the increase in oxidant-antioxidant levels with respect to the control group is attributable to the excess oxygen consumed as a result of regular exercises which leads to oxidative stress.

Key words: Antioxidant, volleyball, lipoprotein, exercise, stress.

INTRODUCTION

As regular exercises provide a protection against coronary heart diseases, heavy exercises increase oxidative stress. In addition to that, a regular exercise also has an enhancer effect on antioxidant systems (Tomas, 2002). Compounds that can prevent the damage caused by free radicals and have the ability to capture and destabilize the free radicals are called “antioxidants” (Elliot, 1999). Trainings can have positive or negative effects on oxidative stress depending on the load and type of the training or the status of the individual prior to it. Different types of exercises are known to cause different levels of oxidative damage (Liu, 2000; Finaud, 2006). Increased

E-mail: is_gokhan@hotmail.com, ismailgokhan@harran.edu.tr. Tel: +90 544 604 63 69, +90 414 3183848. Fax: 90 414 3183439.

oxygen consumption as a result of the exercise also increases the free radical production. These free radicals are neutralized by a defence mechanism consisting of enzymatic and non-enzymatic antioxidants. Total Antioxidant Status (TAS) is accepted as the capacity of antioxidants in biological fluids to protect membranes and other cellular components against oxidative damage (Urso, 2003; MacKinnon, 1999). Brites et al. (1999) determined that regular training program led to increase in total antioxidant capacity levels and superoxide dismutase activity in response to the oxidative stress imposed by physical activity. A significant increase was found in HDL-c levels in response to exercise (Brites et al., 1999). Lipoproteins are particles that composed of a hydrophobic lipid nucleus including nonpolar lipids (triglyceride and cholesterol esters) and native surfactants (phospholipids and free cholesterol) surrounding it, as well as specific proteins called apolipoproteins (Rifai, 1986). Cholesterol is the major lipid for HDL and LDL, and is present in all of the lipoproteins. 70% of all serum cholesterol is found in LDL, and 20% is in HDL (Rifai, 1988). Volleyball as a sport consists of short term stages of exertion and rest. Moreover, volleyball is a sports branch that has successive aerobic and anaerobic loads (Turnagöl, 1994; Abreu et al., 2003). It is important to have such qualities as ability to jump, bloke or spike can affect the outcome of the match. In addition to that, it is a dynamic, physical game with unspecified match time and high tempo (Kenny, 2006). Appropriate nutrition is an essential prerequisite for effective improvement of athletic performance, recovery from fatigue after exercise, and avoidance of injury (Aoi, et al., 2006). Therefore, athletes and active individuals must take an active role in their nutritional well-being (Bonci, 2011).

This study aims to examine the capacity of lipoproteins, total oxidant and antioxidants in volleyball players and sedentaries.

MATERIAL AND METHODS

Subjects

A total of 32 boys participated in this study. 20 of them have average age of 15.20±1.64 and have been playing volleyball for at least 2 years, practising regularly 2 h a day and 3 days a week; the remaining 12 form the control group, with average age of 15.33±1.23 and have been practising any particular sport regularly. It is observed that volleyball players' eating habits are reguler than sedentary group. Prior to the study, medical examination is performed to all subjects. All details of the study are provided and requisite consent forms are obtained from families of the subjects and from Harran University, Faculty of Medicine Ethical Committee. Volleyball players are asked not to eat or drink, or use any kind of antioxidant medicine.

Measurement methods

In order to measure the heights of volleyball players and sedentaries participating in the study, a band with 0.01 meter precision is used; and to measure their weights, a scale with 0.1 kg precision is used.

Oxidant-antioxidant measurements are carried out in the morning, using fasting venous blood samples taken into EDTA tubes. Total Antioxidant Capacity (TAC) is determined by a method developed by Erel, which measures the body's total antioxidant capacity against strong free radicals (Erel, 2004). LOOH levels are measured with a method involving xylenol and Fe^{2+} (Arab and Steghens, 2004). Total Oxidant Status (TOS) is determined by a colorimetric method developed by Erel (Erel, 2004). Oxidative Stress Index (OSI) is calculated using the formula Total Oxidative Stress (TOS) / Total Antioxidant Capacity (TAC) (Erel, 2004). Plasma triglyceride, total cholesterol, LDL, HDL and VLDL parameters are measured using commercial kits (abbot) in automatic chemistry analyzer (Aeroset, USA). All of the blood analyses are carried out in Harran University Research Hospital Biochemistry Laboratory.

Statistical analysis

The comparison between the independent groups, experimental and control groups, are conducted via SPSS 16.00 statistics program using Man-Witney U-test since the case number is less than thirty and the data do not present a normal dispersion. Pearson correlation test is used for the correlation status. Statistically significant difference is accepted as $p<0.05$.

RESULTS

It is observed that the differences between the experimental and control groups regarding age, height, weight and body mass index values are not statistically significant ($p>0.05$), and those regarding TAC, TOS, LOOHs and OSI parameters are statistically significant ($p<0.05$) (Table 1). Among the lipoproteins, plasma triglyceride, total cholesterol, LDL, HDL and VLDL groups, there was no statistically significant difference between them ($p>0.05$). There was also no significant correlation between lipoproteins and oxidative stress parameters ($p>0.05$) (Table 2).

DISCUSSION

In this study, it is found that Total Antioxidant Capacity, Lipid Hydroperoxide, Total Oxidative Stress and Oxidative Stress Index values are significantly higher with respect to the control group ($p<0.05$).

Regular aerobic trainings give rise to an advanced antioxidant system by preventing the oxidative stress caused by the exercise (Bloomer, 2004; Clarkson, 1995). It is also observed in our research that TAC values of volleyball players are significantly higher than that of control group. The increase in TAC values of experimental group of this research is similar to that of other studies in the literature. İnal et al. (2001), in their study regarding middle and short distance swimmers, found an increase in antioxidant levels as a result of aerobic exercise (İnal, 2001). Elosua et al. (2003) argue that the

Table 1. Demographic and clinical measurement values of experimental group (n=20) and control group (n=12).

Parameters	Experimental group n=20	Control group n=12	P
Age (year)	15.20±1.64	15.33±1.23	0.984
Height (cm)	167.65±9.62	165.83±9.31	0.546
Weight (kg)	58.55±10.84	57.16±10.59	0.953
BMI (kg/m^2)	20.76±3.08	20.62±2.20	0.770
OSI (AU)	7.07±1.66	4.91±1.26	0.002**
LOOH (µmol H_2O_2Eqiv./L)	4.23±0.91	3.07±0.69	0.001**
TAC (mmol Trolox equiv./L)	1.76±0.25	1.51±0.24	0.016**
TOS (mmol H_2O_2/L)	8.08±2.16	5.08±1.56	0.001**
Cholesterol	161.10±22.22	162.45±32.06	0.520
Triglyceride	118.75±45.64	150.08±80.12	0.150
HDL	51.05±14.37	46.00±9.89	0.329
LDL	91.05±22.42	86.41±19.12	0.381
VLDL	31.90±20.24	30.16±16.04	0.969

**P < 0.05 Values are given as mean ± standard deviation.

Table 2. The correlation between lipoprotein and oxidative stress parameters of the experimental group.

Parameters		T-Cholesterol	Triglyceride	HDL	LDL	VLDL
OSI	Correlation	0,306	0,175	0,019	0,130	0,000
	P	0,190	0,459	0,936	0,586	0,997
LOOH	Correlation	0,188	-0,034	0,009	0,331	0,103
	P	0,427	0,888	0,971	0,154	0,666
TAC	Correlation	-0,132	-0,133	-0,276	-0,156	-0,176
	P	0,580	0,575	0,239	0,510	0,450
TOS	Correlation	0,277	0,123	-0,007	0,287	0,137
	P	0,237	0,604	0,978	0,220	0,565

**P < 0.05. Values are given as mean ± standard deviation.

submaximal exercises in 75-80% of the VO_2 max. increase the antioxidant enzyme activity (Elosua, 2003). It is also reported that the total plasma antioxidant capacity of elite skiers is raised following a two-day vicious exercise, as oxidative stress levels did not show any sign of increase (Subudhi, 2001). In another study regarding football players and sedentary individuals, it is suggested that footballers have higher levels of oxidative stress and antioxidant activity with respect to sedentaries (Cazzalo, 2003). Watson et al. (2005) state that individuals, who consume antioxidant nutrients and exercise regularly, have a higher level of antioxidant capacity than sedentary individuals (Watson et al., 2005). An antioxidant defence mechanism has a protective role against oxidative stress that increases with the exercise. Regular aerobic trainings are known to prevent exercise-generated oxidative stress, and to induce antioxidant production (Bloomer, 2004). Miyazaki et al. (2001) reported that antioxidant defense mechanism affects a defense performance against the increasing lipid peroxidation during exercise. Coming face to face with a moderate level of chronic oxidative stress has been reported to strengthen the antioxidant defense (Ji, 1993). Mena et al. (1991) reported that professional cyclists' antioxidant enzymes are higher than that of the control group. Moderate intensity exercise on a regular basis develops antioxidant protection (Jenkins, 1988). It is reported that oxidant stress can develop during exercise, and raise the antioxidant capacity when the athletes exert higher physical efforts (Marzatico et al., 1997).

In this research, it is claimed that the increase in TAC values of volleyball players is the result_of regular trainings.

It is observed in this study that LOOH values of volleyball players are significantly higher than that of control group. Cooper et al. reported that physical exercise leads to an increase in lipid peroxidation (2002). Gougoura et al. found that lipid peroxidation in swimmer children is higher than that of individuals in a control group (2007).

As it is known that different types of exercise result in different levels of oxidative stress, it can also be said that

regular exercises reduce oxidative proteins. On the other hand, oxidative stress may not be produced with an exercise of 50 % VO_2 max. (Radak et al., 2001; Liu et al., 2000; Finaud, 2006). In another research it is reported that high-intensity exercise can increase oxidative stres (Goto et al., 2003). On the other hand, chronic exercise was shown to increase antioxidant defense and reduce the basal level of oxidative stress in adults (Noyan et al., 2008). In this study, it is observed that TOS and OSI values are significantly higher in volleyball players than in control group. Wang and Huang (2005), in their study, showed that oxidative stress rises in sedentary individuals who exercised sub-maximally (Wang and Huang, 2005). Gougoura et al. also found in their study that TOS values of swimmers were high (2007). In modern medicine, regular physical exercise is an important tool for the prevention and treatment of diseases. Although intense exhaustive exercise increases oxidative stress, training exercise has been shown to up-regulate antioxidant protection (Atalay and Laaksonen, 2002).

In this study, it is suggested that the high values of TOS and OSI can be attributed to aerobic and anaerobic content of training.

As is known, proper nutrition is important in individuals for increasing the antioxidant capacity. Goldfarb et al. reported that MDA levels known as product of lipid peroxidation was found lower in antioxidant supplementary group (2005). Kanter et al. applied a 30-min run test (max.VO_2 of 60%) in 20 healthy males after antioxidant vitamin supplements. Following the test, at MDA levels of subjects, a significant decreasewas observed (Kanter et al., 1993)

As a result, it could be concluded that the reason for the increase in oxidant-antioxidant values of volleyball players with respect to the control group may be the excess oxygen consumed in regular exercises and the concomitant oxidative stress. It is also believed that the antioxidant capacity of the body against the oxidative stress is enhanced with regular exercises. It is known that doing any sport causes oxygen consumption, therefore inflicting oxidative stress. It can be suggested that in order for volleyball players to protect themselves from oxidative stress, antioxidant-rich diets and antioxidant supplements may be useful.

ACKNOWLEDGEMENT

This article was presented as a poster at the Sport Science Congress in Egypt/Luxor – 2012

REFERENCES

Abreu T, Almeidal D, Soares EA (2003). Nutritional and Anthropometric Profile of Adolescent Volleyball Athletes. Rev. Bras. Med. Esporte. 9:4.

Aoi W, Naito Y, Yoshikawa T (2006). Exercise and functional foods**,** Jun 5;5:15. PMID: 16749944.

Arab K, Steghens JP (2004). Plasma lipid hydroperoxides measurement by an automated xylenol orange method. Anal. Biochem. 325:158-163.

Atalay M, Laaksonen DE (2002). Diabetes, oxidative stress and physical exercise. J. Sport Sci. Med. 1:1-14.

Bloomer RJ, Goldfarb AH (2004). Anaerobic Exercise and Oxidative Stres: A Review. Can. J. Appl. Physiol. 29(3):245-263.

Bonci LJ (2011). Eating for performance: bringing science to the training table. Clin. Sports Med. 30(3):661-670.PMID: 21658554.

Brites FD, Evelson PA, Christiansen MG, Nicol MF, Basilico MJ, Wikinski RW, Llesuy SF (1999). Soccer players under regular training show oxidative stress but an improved plasma antioxidant status. Clin. Sci. (Lond). 96:381-385.

Cazzalo R, Russo-Volpe S, Cervato G, Cestaro B (2003). Biochemical Assessments of Oxidative Stress, Erythrocyte Membrane Fluidity and Antioxidant Status in Professional Soccer Players and Sedentary Controls. Eur. J. Clin. Invest. 33:924-930.

Clarkson PM (1995). Antioxidants and physical performance. Crit Rev Food Sci. Nutr. 35:131-141.

Cooper CE, Vollaard NBJ, Choueiri T, Wilson MT (2002). Exercise, free radicals and oxidative stress. Biochem. Soc. Trans. 30:280-284.

Elliot JG (1999). Application of antioxidant vitamins in foods and beverages. Food Tech. 53(2):46-48.

Elosua R, Molina L, Fito M, Arquer A, Sanchez-Quesada JL, Covas MI, Ordonez-Llanos J, Marrugat J (2003). Response of Oxidative Stres Biomarkers to a 16-week Aerobic Physical Activity Program, and to Acute Physical Activity, in Healthy Young Men And Women. Atherosclerosis 167:327-334.

Erel O (2004). A novel automated method to measure total antioxidant response against potent free radical reactions. J. Clin. Biochem. 37:112-119.

Finaud J, Lac G, Filaire E (2006). Oxidative stress: Relationship with exercise and training. Sports Med. 36:327-358.

Goldfarb AH, Bloomer RJ, McKenzie MJ, (2005). Combined antioxidant treatment effects on blood oxidative stress after eccentric exercise. Med. Sci. Sports Exerc.37(2):234-239.

Goto C, Higashi Y, Kimura M, Noma K, Hara K, Nakagava K, Kawamura M, Chayama K, Yoshizumi M, Nara I (2003). Effect of different intensities of exercise on endothelium-dependent vasodilatation in humans; role of endothelium-dependent nitric oxide and oxidative stres, Circulation 5; 108(5):530-535. Epub.

Gougoura S, Nikolaidis MG, Kostaropoulos IA, Jamurtas AZ, Koukoulis G, Kouretas D (2007). Increased oxidative stress indices in the blood of child swimmers. Eur. J. Appl. Physiol. 100:235-239.

İnal M, Akyüz F, Turgut A, Getsfrid WM (2001). Effect of Aerobic and Anaerobic Metabolism on Free Radical Generation Swimmers. Med. Sci. Sports Exerc. 33:564-567.

Jenkins RR (1988). Free radical chemistry relationship to exercis. Sports Med. 5(3):156-170.

Ji LL (1993). Antioxidant enzyme response to exercise and aging. Med. Sci. Sports Exerc. 25(2):225-231.

Kanter MM, Nolte LA, Holloszy JO (1993). Effects of an antioxidant vitamin mixture on lipid peroxidation at rest and postexercise. J Appl Physiol. 1993 Feb;74(2):965-9.

Kenny B, Gregory C (2006). Voleyball Step to Success 1 Sports Instruction Series. 9-10.

Liu J, Yeo HC, Overvik-Douki E, Hagen T, Doniger SJ, Chyu DW, Brooks GA, Ames BN (2000). Chronically and acutely exercised rats: biomarkers of oxidative stress and endogenous antioxidants, J Appl Physiol, 89, 21-28.

MacKinnon KL, Molnar Z, Lowe D, Watson ID, Shearer E (1999). Measures of total free radical activity in critically ill patients. Clin. Biochem. 32:263-268.

Marzatico F, Pansarasa O, Bertorelli L, Somenzini L, Della Valle G (1997). Blood free radical antioxidant enzymes and lipid peroxides following long-distance and lactacidemic performances in highly trained aerobic and sprint athletes. J. Sports Med. Phys. Fitness 37:235-239.

Mena P, Maynar M, Gutierrez JM, Maynar J, Timon J, Campillo JE (1991). Erythrocyte free radical scavenger enzymes in bicycle professional racers. Adaptation to training. Int. J. Sports Med. Decis. 12(6):563-566. PMID: 1797698.

Miyazaki H, Oh-Ishis, Kizakit OT, Toshinai K, Haga SS, Jil L, Ohno H (2001). Strenuous endurance training in humans reduces oxidative stres following exhausting exercise. Eur. J. Appl.Pysiol. 84:1-6.

Noyan T, Kıroğlu AF, Kara T, Keskin S (2008). Investigation of changes in oxidative stress before and after nasal packing following nasal septoplasty. Türkiye Klinikleri J Med Sci 2008; 28(3):259-264.

Radak Z, Taylor AW, Sasvari M, Ohno H, Horkay B, Furesz J, (2001). Telomeraseactivity is not altered by regular strenuous exercise in skeletal muscle or by sarcoma inliver of rats. Redox Rep, 6, 99-103.

Rifai N (1986). Lipoproteins and apoproteins. Arch Pathol Lab Med; 110: 694-701.

Rifai N (1988). Review of serum lipids and apolipoproteins in risk assesment of coronary heart disease. Ann Clin Lab Sci; 18(6): 429-39.

Subudhi AW, Davis SL, Kipp RW, Askew EW (2001). Antioxidant status and Oxidative stress in elite alpine ski racers. Int. J. Sport Nutr. Exerc. Metab. 11:32-41.

Tomas MR, Elosua M, Senti L, Molina J, Vila R, Anglada M, Fito M, Covas I, Marrugat J (2002). PON1-192 polymorphism modulates the effects of regular and acute exercise on paraoxonase1 activity. J Lipid Res. 43:713-720.

Turnagöl H (1994). Voleybolda Enerji Sistemleri, Hacettepe Üniversitesi Voleybol Bilim ve Teknoloji Dergisi 2:34-37.

Urso ML, Clarkson PM (2003). Oxidative stress, exercise, and antioxidant supplementation. Toxicology 189:41-54.

Wang JS, Huang YH (2005). Effects of exercise intensity on lymphocyte apoptosis induced by oxidative stress in men. Eur. J. Appl. Physiol. 95(4):290-297.

Watson TA, Macdonald WL, Garg ML (2005). Oksidative stres and antioxidants in athletes undertaking regular exercise training. Int. J. Sport Nutr. Exerc. Metab. 15(2):131-146.