Original Article

Oxidative stress and total antioxidant capacity in handball players

Gholamreza Sharifi, Azam Bagheri Najafabadi[1], Fatemeh Esteki Ghashghaei[2]

Department of Exercise Physiology, Faculty of Physical Education and Sport Sciences, Islamic Azad University, Khorasgan Branch, Isfahan, [1]Department of Exercise Physiology, Faculty of Physical Education and Sport Sciences, Islamic Azad University, Fars, [2]Ph.D Candidate, Isfahan Neurosciences Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran

Abstract

Background: Exercise training increases oxygen consumption, which was associated with the high generation of reactive oxygen species and markers of lipid peroxidation in the blood. The aim of this study was to assess the responses of total antioxidant capacity (TAC), biomarker of oxidative stress and erythrocyte, leukocyte and hematocrit (Hct) levels in plasma in athlete girls (handball players) and non-athlete girls.

Materials and Methods: We evaluated two groups, which known as athlete and non-athlete women and they were similar in anthropometric characteristics. The athletic women engaged in the regular handball training 3 times a week for at least 6 months. However, non-athletic women didn't have any regular activity over the last 6 months. Each subject referred to the lab and after 12 h fasting, the blood samples were taken for measuring all variables. Independent sample *t*-tests were used to identify the differences.

Result: Significant differences were observed in malondehyde ($P = 0.00$), red blood ($P = 0.00$) cell and hemoglobin ($P = 0.00$). However, other evaluated factors such as of TAC, white blood cell, Hct and the mean corpuscular volume were higher in athletes than in non-athletes, but statistical significant differences weren't seen in these variables between two groups.

Conclusion: Regular exercise training for handball players may increase the activity of antioxidant enzymes and blood cells and reduces oxidant production.

Key Words: Erythrocyte, hematocrit, leukocyte, oxidative stress, total antioxidant capacity

Address for correspondence:
Miss. Fatemeh Esteki Ghashghaei, Ph.D Candidate, Isfahan Neurosciences Research Center, Isfahan Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: Estekifatemeh@yahoo.com
Received: 23.10.2012, **Accepted:** 15.05.2013

Access this article online	
Quick Response Code:	Website: www.advbiores.net
	DOI: 10.4103/2277-9175.139538

INTRODUCTION

Exercise training increases oxygen consumption by the whole body particularly by muscles. The increase in oxygen uptake during the strenuous exercise is associated with the excessive generation of reactive oxygen species (ROS) and markers of lipid peroxidation in the blood.[1,2] In addition, the antioxidant enzymes, which constitute a defense mechanism against ROS affect by the exercise. It has been reported that

How to cite this article: Sharifi G, Najafabadi AB, Ghashghaei FE. Oxidative stress and total antioxidant capacity in handball players. Adv Biomed Res 2014;3:181.

insufficient levels of antioxidant during the intensive exercise training and imbalance between the expression of ROS and biological system's ability to remove the free radicals lead to the cellular loss of redox homeostasis and oxidative damage in lipids, proteins and consequently result in oxidative stress in cells and tissues.[3] Oxidative stress, which is a well-established mechanism of cellular injury plays a significant role in the development of many diseases such as diabetes, cancer, cardiovascular disorders, influenza and others.[4]

On the other hand, according to many studies, regular exercise training leads to an increase in the antioxidant enzymes level and their activities in the muscles and repair the resulting damage from ROS and lipid peroxidation.[5-7]

Since handball is considered as repeated sessions of exercise, competitive games and high volume of physical demanding exercise that places important stress on a player's aerobic metabolism and it involves a large number of anaerobic actions such as body contact, repeated accelerations, sprints, jumps, throwing, blocking, pushing and rapid changes in moving directions may have effects on biomarkers of oxidative stress and total plasma antioxidants. To our knowledge, there has not been any report regarding the responses of total antioxidant capacity (TAC), Malondialdehyde (MDA) as a biomarker of oxidative stress and erythrocyte, leukocyte and hematocrit (Hct) levels in plasma in athlete women (handball players). Hence, the aim of this study was to compare the effect of handball training on these variables between athlete women and non-athlete women.

MATERIALS AND METHODS

In this study, we evaluated two groups that were the university students. The case group was comprised of 15 athlete women (handball players) and control group was consisted of 15 non-athletic girls. The athletic women engaged in the regular handball training 3 times a week for at least 6 months. However, the subjects in the control group didn't have any regular activity over the last 6 months. All participants had given written informed consent and they were completed the questionnaire including demographic information, medical history, smoking and diet. All subjects were healthy without familial or personal history of diseases and none of them was taking any drugs, coffin, vitamins and antioxidant supplements. In addition, none of them was following a special diet and they prohibited to consume too much fish oil, soya, sunflower seeds, cacao, fruits, vegetable and multivitamins which affected the results of the test.

In addition, having the normal menstrual cycles had been emphasized. The 3rd day of their menstrual period, each subject referred to the lab and after 12 h fasting, the blood samples were taken by the biologist for measuring MDA, TAC and red blood cell (RBC) and white blood cells (WBC) counts, hemoglobin (Hb), Hct and the mean corpuscular volume (MCV). Samples were maintained in the coldchamber (−18°C) for 20 min until separation by centrifugation at 2000 g for 15 min at (−18°C).

It should be noticed this study was approved by the Ethics Committee of the University. Independent sample *t*-tests were used to identify the differences between two groups. Results are expressed as mean and standard deviation (SD) and the level of significance was set at $P < 0.05$.

RESULT

A total of 30 university students were evaluated and they were separated into athletes and non-athletes. Athlete group (n = 15, age = 22.14 ± 2.30 years) and non-athlete group (n = 15, age = 23.18 ± 1.80 years). Independent sample *t*-tests were used to identify baseline differences among athlete and non-athlete groups. Anthropometric characteristics of them are shown in Table 1. Both groups were of similar age, weight, height and body mass index. In addition, for comparison the two groups, we used independent *t*-test either [Table 2]. Significant differences were observed in MDA, RBC and Hb. However, other evaluated factors such as TAC, WBC, Hct and MCV

Table 1: Anthropometric characteristics of two groups

Variables *N* = 15	Athlete group mean ± SD	Non-athlete group mean ± SD	*P* value
Age (years)	22.14±2.30	23.18±1.80	0.22
Weight (kg)	59.58±8.49	61.18±10.21	0.42
Height (m)	1.59±0.46	1.62±0.65	0.12
Body mass index (kg/m^2)	23.38±3.1	23.32±3.93	0.94

Table 2: Oxidative stress, total antioxidant capacity and hematological indexes in athlete group and non-athlete group

Variables	Athlete group mean ± SD	Non-athlete group mean ± SD	*P* value
MDA	7.38±1.84	8.47±1.65	0.00
TAC	3131.62±402.90	3033±535.96	0.32
WBC	5.91±1.72	5.82±1.42	0.79
RBC	4.34±0.29	4.19±0.21	0.00
HB	12.38±1.15	12.14±0.75	0.00
HCT	38.06±2.90	37.61±1.81	0.37
MCV	88.22±7.03	86.86±11.04	0.48

MDA: Malondialdehyde; TAC: Total antioxidant capacity; WBC: Wight blood cell; RBC: Red blood cell; HB: Hemoglobin; HCT: Hematocrit; MCV: Mean corpuscular volume were higher in athletes than in non-athletes, but statistical significant differences weren't seen in these variables between two groups.

DISCUSSION

In this study, we found that MDA level in the athlete group was lower than in the non-athlete group. In addition, there were significant differences in the level of RBC and HB between two groups, which were higher in the athlete group.

The activities of TAC, WBC, HCT and MCV in the athlete group were greater than the non-athlete group; however, these differences weren't statistical significant.

There were many studies that proposed our results.[8,9] For example, Aslan *et al*. investigated the effect of regular exercise training for 5 weeks and concluded that regular exercise makes individuals stronger against oxidative stress and increases antioxidant defense system and provides a healthy life.[10]

Another study demonstrated that a single handball game in elite athletes induces the oxidative modification in plasma and erythrocyte macromolecules as well as by changes in the enzymatic and non-enzymatic antioxidant system.[11]

In addition, the finding of Brites *et al*. showed that regular training has beneficial effects in plasma antioxidant status in soccer players in comparison to sedentary controls.[1]

Furthermore, Lovlin *et al*. which surveyed two kinds of exercise training concluded that exhaustive maximal exercise induces free radical generation while short periods of submaximal exercise may inhibit it and lipid peroxidation.[12]

In this regard, Afzalpour *et al*. suggested a correlation between physical training and improvement in the antioxidant defense system.[13]

The study of Ramel *et al*. proved that even regular resistance training partly prevents lipid peroxidation during exercise.[14]

Another related study considered the effects of aerobic and anaerobic training on serum lipid peroxidation levels and antioxidant enzyme activities so that, the results suggested aerobic training increased erythrocytes activity in plasma, but anaerobic training had no effect.[15]

Another examination revealed that long-term exercise training increases resting levels of erythrocyte in the exercise group compared with the control group; furthermore, antioxidant enzyme activities were increased following long-term exercise training.[16,17]

On the basis of the investigations, we can notify strenuous exercise in people causes disorders of the homeostasis and it may increase oxidant levels and oxidative stress.[2] The condition of oxidative stress develops when the balance between oxidants and antioxidants is interrupted owing to depletion of antioxidants or excess gathering of ROS; and consequently, MDA which is a marker of lipid peroxidation presents.[8,18] According to the article, muscles adapt to exercise training by increasing gene expression in the regulation of antioxidant enzymes.[18]

On the other hand, high levels of cytoplasmic antioxidants are found in RBCs, which work against ROS to protect the RBC from the harmful potential of oxidative stress. In fact, to encounter with the destructive effects of ROS, RBCs have effective antioxidative enzyme systems that nullify the reactive oxidants. Regularly performed exercise might induce an adaptive enhancement in skeletal muscle and the erythrocyte of the defense mechanisms that protect against free radical damage in athletes.[3]

Like our study, Kelle *et al.* observed the significant increases in RBC count, Hb concentration, WBC and Hct after the half-marathon that were the result of exercise before the race.[19]

It should be noted if our investigation didn't show any statistical significant in some variables and if we observed some variations with other studies; we can deduce, these differences may be resulted from sex differences, subjects' population and even the kind, intensity and the period of exercise training.

We concluded that regular exercise training may increase the activity of antioxidant enzymes and reduces oxidant production and markers of lipids peroxidation like MDA. In fact, sequential bouts of handball training induce adaptations that increase the blood cells and some Hct levels to protect against ROS and prevent massive oxidative damage.

REFERENCES

1. Brites FD, Evelson PA, Christiansen MG, Nicol MF, Basílico MJ, Wikinski RW, *et al*. Soccer players under regular training show oxidative stress but an improved plasma antioxidant status. Clin Sci (Lond) 1999;96:381-5.
2. Alessio HM. Exercise-induced oxidative stress. Med Sci Sports Exerc 1993;25:218-24.

3. Pandey KB, Rizvi SI. Biomarkers of oxidative stress in red blood cells. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub 2011;155:131-6.
4. Banerjee AK, Mandal A, Chanda D, Chakraborti S. Oxidant, antioxidant and physical exercise. Mol Cell Biochem 2003;253:307-12.
5. Leeuwenburgh C, Heinecke JW. Oxidative stress and antioxidants in exercise. Curr Med Chem 2001;8:829-38.
6. Gündüz F, Sentürk UK, Kuru O, Aktekin B, Aktekin MR. The effect of one year's swimming exercise on oxidant stress and antioxidant capacity in aged rats. Physiol Res 2004;53:171-6.
7. Venditti P, Masullo P, Di Meo S. Effect of training on H(2)O(2) release by mitochondria from rat skeletal muscle. Arch Biochem Biophys 1999;372:315-20.
8. El Abed K, Rebai H, Bloomer RJ, Trabelsi K, Masmoudi L, Zbidi A, *et al*. Antioxidant status and oxidative stress at rest and in response to acute exercise in judokas and sedentary men. J Strength Cond Res 2011;25:2400-9.
9. Radovanovic D, Jakovljevic V, Cvetkovic T, Ignjatovic A, Veselinovic N, Dondur S. Effects of different exercise program on blood markers of oxidative stress in young women. Fiziologia 2008;18:16-20.
10. Aslan R, Sekeroglu MR, Tarakcioglu M, Bayiroglu F, Mera I. Effect of acute and regular exercise on antioxidative enzymes, tissue damage markers and membran lipid peroxidation of erythrocytes in sedentary students. Tr J Med Sci 1998;28:411-4.
11. Marin DP, dos Santos Rde C, Bolin AP, Guerra BA, Hatanaka E, Otton R. Cytokines and oxidative stress status following a handball game in elite male players. Oxid Med Cell Longev 2011;2011:804873.
12. Lovlin R, Cottle W, Pyke I, Kavanagh M, Belcastro AN. Are indices of free radical damage related to exercise intensity. Eur J Appl Physiol Occup Physiol 1987;56:313-6.
13. Afzalpour ME, Gharakhanlou R, Gaeini AA, Mohebbi H, Hedayati M, Khazaei M. The effects of aerobic exercises on the serum oxidized LDL and total antioxidant capacity in non-active men. CVD Prev Control 2008;3:77-82.
14. Ramel A, Wagner KH, Elmadfa I. Plasma antioxidants and lipid oxidation after submaximal resistance exercise in men. Eur J Nutr 2004;43:2-6.
15. Selamoglu S, Turgay F, Kayatekin BM, Gönenc S, Yslegen C. Aerobic and anaerobic training effects on the antioxidant enzymes of the blood. Acta Physiol Hung 2000;87:267-73.
16. Djordjevic D, Cubrilo D, Macura M, Barudzic N, Djuric D, Jakovljevic V. The influence of training status on oxidative stress in young male handball players. Mol Cell Biochem 2011;351:251-9.
17. Shin YA, Lee JH, Song W, Jun TW. Exercise training improves the antioxidant enzyme activity with no changes of telomere length. Mech Ageing Dev 2008;129:254-60.
18. Radovanovic D, Rankovic G. Oxidative stress, stress proteins and antioxidants in exercise. AMM 2004;43:45-7.
19. Kelle M, Diken H, Sermet A, Atmac M, Kocyigit Y. Changes in blood antioxidant status and lipid peroxidation following distance running. Tr J Med Sci 1998;28:643-7.

Source of Support: Nil, **Conflict of Interest:** None declared.