http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 17 (2): 297-300, 2014
ISSN 1028-8880 / DOI: 10.3923/pjbs.2014.297.300

Effect of Exercise on Serum Adiponectin and Lipoprotein Levels in Male Rat

[1]Ranah Mahmoodi, [1]Farhad Daryanoosh, [2]Somayeh Kasharafifard, [1]Mehran Hoseini,
[3]Nader Tanideh, [3]Davood Mehrabani and [4]Amir Almasi-Hashiani
[1]Department of Physical Education, School of Education and Psychology, Shiraz University, Shiraz, Iran
[2]Department of Exercise Physiology, Central Tehran Branch, Islamic Azad University, Tehran, Iran
[3]Stem Cell and Transgenic Technology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
[4]Department of Epidemiology, Arak University of Medical Sciences, Arak, Iran

Abstract: The effect of exercise and recovery period on adiponectin level is not still cleared. The aim of this study was to evaluate the effect of different intensities of running on serum adiponectin and lipoproteins levels in male rats. In this experimental study, one hundred and sixty rats aged 2 months years old (250±5 g) were randomly assigned into four groups including the control and the 3 groups running at the speeds of 18, 24 and 30 m min^{-1} for 30 min. Serum adiponectin, Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL) levels were evaluated in four stages: Before running, immediately, 30 min and 5 h after the running finished. In different stages, 10 rats of each group were anesthetized and blood were collected from abdominal aorta. Serum adiponectin concentrations increased immediately after running in the rats ran with the speeds of 18, 24 and 30 m min^{-1} in 30 min ($p<0.05$). Thirty minute after running, serum adiponectin concentrations did not change only in the rats ran with the speed of 18 m min^{-1} ($p = 0.46$). Five hours after running, serum adiponectin concentrations approximately reached into the before running levels in the rats ran with the speeds of 18, 24 and 30 m min^{-1} ($p<0.05$). There was no significant difference in serum LDL and HDL concentrations between and within rat groups ($p>0.05$). Serum adiponectin concentrations rose when the running intensities in one exercise session increased in male rats. During recovery period, serum adiponectin concentrations decreased with the same pattern in different exercise intensities.

Key words: Adiponectin, running intensity, recovery, lipoprotein

INTRODUCTION

Adiponectin is a 30 kD protein that is produced and secreted from adipose cell tissue (adipocytes) (Maeda *et al*., 1996; Scherer *et al*., 1995) and its concentration in human and rodents is 2-30 mg lit^{-1} (Arita *et al*., 1999; Chandran *et al*., 2003). Adiponectin was shown to increase in response to the weight loss (Boudou *et al*., 2003) as it is responsible for regulation of glucose and lipid metabolism (Maeda *et al*., 1996). Physical activity, possibly by releasing free fatty acids from the adipocytes would result into changes in lipid metabolism (Zeng *et al*., 2007). It was demonstrated that a decrease in adiponectin level would increase the blood free fatty acids (Bernstein *et al*., 2004). Several studies showed that exercises with different intensity could not induce any change in the adiponectin level (Ferguson *et al*., 2004; Hulver *et al*., 2002; Rumi *et al*., 2005; Yatagai *et al*., 2003), whereas in other studies, aerobic and anaerobic exercise could increase the circulating adiponectin level (Jurimae *et al*., 2005; Kriketos *et al*., 2004; Zeng *et al*., 2007) as moderate exercises would increase the expression of mRNA which regulates the production of adiponectin receptors in muscular and hepatic tissues. Still, the effect of exercise on changes in adiponectin level has not been clarified. The aim of this study was to evaluate the effect of different intensities of running on serum adiponectin and lipoproteins levels in male rats as an animal model.

MATERIALS AND METHODS

One hundred female 2 months old Sprgue Dawley rats with the weight of 200±5 g provided from Laboratory Animal Center of Shiraz University of Medical Sciences were randomly divided into 4 equal groups. Group 1-3 underwent running exercise but under different speeds including 18, 24, 30 m min^{-1}, respectively and Group 4 was considered as control.

Corresponding Author: Somayeh Kasharafifard, Department of Exercise Physiology,Central Tehran Branch, Islamic Azad University, Tehran, Iran Tel: +98-917-7180361 Fax: +98-711-6475570

All animals were housed identically as four rats per cage in a condition of 12 h light/dark cycle with environmental temperature of 21±2°C and relative humidity of 50%. They were fed with standard pellets and had access to food and water *ad libitum*. Animal selection, all experiments, subsequent care and sacrifice procedure were all adhered to the same guide lines under supervision of Animal Care Committee of Iran Veterinary Organization. All experiments were carried out under aseptic conditions in Comparative Medicine Research Center of Shiraz University of Medical Sciences. The protocol of anesthesia and sacrifice were identical for all animals.

The running exercise was undertaken on a flatted treadmill with 2 min warm-up exercise program (12 m min^{-1}) continued for 30 min. Exercises were performed in the morning. No electric shock or artificial stimulation was used at during the study. Anesthesia was done with a mixture of 2% xylazine and 10% ketamine (8 and 90 mg kg^{-1}, respectively). Animals were bled from abdominal aorta under anesthesia in four stages (before and immediately after exercise, 30 min and 5 h after exercise). The blood samples were centrifuged (3000 rpm for 10 min) and their serum samples were kept at -80°C. ELISA test (Orgonium, Finland, 011209) was used to determine the adiponectin level and auto ELISA test (Hitachi, 717) was applied to evaluate the LDL and HDL levels (PARS, Iran).

Statistical analysis was performed using SPSS software (version 16.0, Chicago, IL, USA) with One-way ANOVA, LSD and Paired-samples (t-test) tests and a p = 0.05 was considered significant.

RESULTS

Serum adiponectin concentration showed a significant increase immediately after exercise in rats of groups 1-3 (8.2, 9.4 and 9.6 μg mL^{-1}, respectively), (p<0.01, Fig. 1a). In group 1, 30 min after exercise (8.02 μg mL^{-1}) the increase was not significant (p = 0.46) but in groups 2 (8.32 μg mL^{-1}) and 3 (8.4 μg mL^{-1}) was significant. In groups 1 (6.8 μg mL^{-1}) and 2 (7.2 μg mL^{-1}), five hr after exercise, a significant decrease was visible in comparison to the control group (7.5 μg mL^{-1}) (p = 0.001). In groups 2 and 3, this change was a significant increase (p<0.01). There was no statistically significant differences (p>0.05) in levels of LDL (Fig. 1b) and HDL (Fig. 1c) between and within the groups of rats.

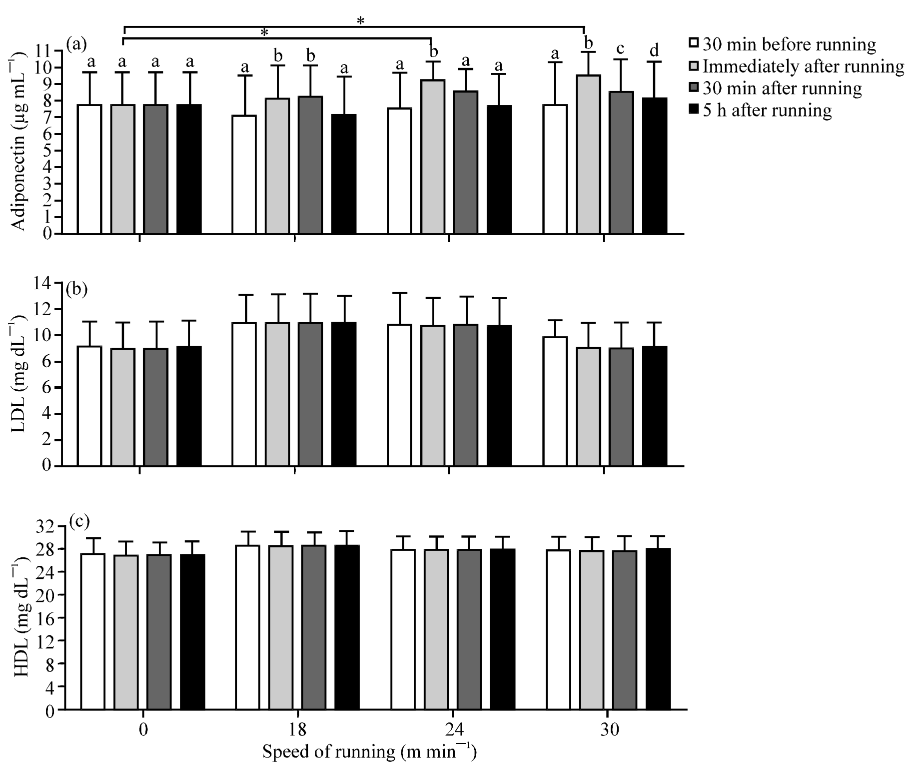

Fig. 1 (a-c): Serum concentration (a) Adiponectin (μg mL^{-1}), (b) LDL (mg dL^{-1}) and (c) HDL (mg dL^{-1})

DISCUSSION

We showed that adiponectin level increased in male rats 30 min after running exercise. Similar findings were noticed after 12 weeks of moderate and high intensity exercises (Mohebi *et al*., 2009). In another study, physical activity increased the high molecular weight adiponectin level in healthy male rats and when exercise intensity increased, the high molecular weight adiponectin level increased more (Mohhebat *et al*., 2009). Also, adiponectin concentration decreased after 30 min and 5 h of running exercise under different speeds. In professional sailors after 6000 m of rowing during a 20 min period, the adiponectin level decreased but 30 min after the exercise, the adiponectin level increased (Jurimae *et al*., 2005). Similar changes were seen in plasma adiponectin concentration in amateur sailor (Mohhebat *et al*., 2009). It was shown that adiponectin level increases in human in anaerobic conditions as all muscles are involved in the 30 min first of recovery period after a short-term exercise training exercise (Jurimae *et al*., 2006). Plasma adiponectin concentration in obese subjects immediately after 45 min and after 24 and 48 h of severe aerobic exercise, training did not change the recovery period (Kraemer *et al*., 2003). In healthy men, 30 min continuous and heavy running exercise had no effect on plasma adiponectin level but in ski men, the 14 days severe intensity exercise increased the adiponectin level (Eriksson *et al*., 2008). In women treated for breast cancer, the adiponectin and high molecular weight adiponectin levels did not change after 16-week training exercise (Ligibel *et al*., 2009). Long-term exercise in man had no effect on serum adiponectin concentration (Bouassida *et al*., 2010) while our findings and other researches (Bouassida *et al*., 2010; Hojbjerre *et al*., 2007) indicated that the short-term exercise increased adiponectin level immediately in blood of rats or 30-minute after exercise in human. A decrease in adiponectin level is expected 5 h after the recovery period in rats but in human more studies seem necessary. Present results showed that after 30 min running exercise with different intensities, no change in LDL and HDL levels were observed. Identically, Varady observed that severe exercise increased the adiponectin concentration but did not change the LDL and HDL levels (Varady *et al*., 2010). In obese people, an increase in adiponectin level and reduction in lipid profiles were noticed after 6 weeks of training (Kim *et al*., 2007). Adiponectin level in long-term exercises together with a diet plan in obese girls were more effective than those just with a diet plan or exercise alone, even the total cholesterol and LDL levels decreased (Ounis *et al*., 2008). It was shown that 2 to 3 times per week of aerobic exercise led to a weight loss and an increase in the adiponectin level and a decrease in LDL level but no change for HDL was seen (Yoshida *et al*., 2010). After menopause in women athletes, no relationship was noticed between adiponectin and plasma lipoprotein levels (Jurimae *et al*., 2010). In women with high blood fat level, no change in adiponectin level was seen but the LDL level reduced and HDL level increased after 6 months weight loss exercise program (Santosa *et al*., 2007). The results of this study showed that concentrations of LDL and HDL did not significantly change with the exercise program.

CONCLUSION

We showed that with increasing of intensity during a 30 min running exercise, the adiponectin level increased but lipoprotein did not show any change in male rats. In recovery period with different intensities, adiponectin level showed a decrease identically. It seems that with an increasing exercise program, the metabolic rate a rise in adiponectin level would be responsible for maintenance of the energy homeostasis.

ACKNOWLEDGMENT

The authors would like to thank Shiraz University for financial support.

REFERENCES

Arita, Y., S. Kihara, N. Ouchi, M. Takahashi and K. Maeda *et al*., 1999. Paradoxical decrease of an adipose-specific protein, adiponectin, in obesity. Biochem. Biophys. Res. Commun., 257: 79-83.

Bernstein, E.L., P. Koutkia, K. Ljungquist, J. Breu, B. Canavan and S. Grinspoon, 2004. Acute regulation of adiponectin by free fatty acids. Metabolism, 53: 790-793.

Bouassida, A., K. Chamari, M. Zaouali, Y. Feki, A. Zbidi and Z. Tabka, 2010. Review on leptin and adiponectin responses and adaptations to acute and chronic exercise. Br. J. Sports Med., 44: 620-630.

Boudou, P., E. Sobngwi, F. Mauvais-Jarvis, P. Vexiau and J.F. Gautier, 2003. Absence of exercise-induced variations in adiponectin levels despite decreased abdominal adiposity and improved insulin sensitivity in type 2 diabetic men. Eur. J. Endocrinol., 149: 421-424.

Chandran, M., T. Ciaraldi, S.A. Phillips and R.R. Henry, 2003. Adiponectin: More than just another fat cell hormone? Diabetes Care, 26: 2442-2450.

Eriksson, M., O. Johnson, K. Boman, G. Hallmans, G. Hellsten, T.K. Nilsson and S. Soderberg, 2008. Improved fibrinolytic activity during exercise may be an effect of the adipocyte-derived hormones leptin and adiponectin. Thrombosis Res., 122: 701-708.

Ferguson, M.A., L.J. White, S. McCoy, H.W. Kim, T. Petty and J. Wilsey, 2004. Plasma adiponectin response to acute exercise in healthy subjects. Eur. J. Applied Physiol., 91: 324-329.

Hojbjerre, L., M. Rosenzweig, F. Dela, J.M. Bruun and B. Stallknecht, 2007. Acute exercise increases adipose tissue interstitial adiponectin concentration in healthy overweight and lean subjects. Eur. J. Endocrinol., 157: 613-623.

Hulver, M.W., D. Zheng, C.J. Tanner, J.A. Houmard and W.E. Kraus *et al*., 2002. Adiponectin is not altered with exercise training despite enhanced insulin action. Am. J. Physiol. Endocrinol. Metab., 283: E861-E865.

Jurimae, J., P. Purge and T. Jurimae, 2005. Adiponectin is altered after maximal exercise in highly trained male rowers. Eur. J. Applied Physiol., 93: 502-505.

Jurimae, J., P. Hofmann, T. Jurimae, J. Maestu and P. Purge *et al*., 2006. Plasma adiponectin response to sculling exercise at individual anaerobic threshold in college level male rowers. Int. J. Sports Med., 27: 272-277.

Jurimae, T., J. Jurimae, A. Leppik, E. Tafeit and T. Kums, 2010. Relationships between adiponectin, leptin and blood lipids in physically active postmenopausal females. Am. J. Human Biol., 22: 609-612.

Kim, E.S., J.A. Im, K.C. Kim, J.H. Park and S.H. Suh *et al*., 2007. Improved insulin sensitivity and Adiponectin level after exercise training in obese Korean youth. Obesity, 15: 3023-3030.

Kraemer, R.R., K.S. Aboudehen, A.K. Carruth, R.J. Durand and E.O. Acevedo *et al*., 2003. Adiponectin responses to continuous and progressively intense intermittent exercise. Med. Sci. Sports Exercise, 35: 1320-1325.

Kriketos, A.D., S.K. Gan, A.M. Poynten, S.M. Furler, D.J. Chisholm and L.V. Campbell, 2004. Exercise increases Adiponectin levels and insulin sensitivity in humans. Diabetes Care, 27: 629-630.

Ligibel, J.A., A. Giobbie-Hurder, D. Olenczuk, N. Campbell, T. Salinardi, E.P. Winer and C.S. Mantzoros, 2009. Impact of a mixed strength and endurance exercise intervention on levels of adiponectin, high molecular weight adiponectin and leptin in breast cancer survivors. Cancer Causes Control, 20: 1523-1528.

Maeda, K., K. Okubo, I. S himomura, T. Funahashi, Y. Matsuzawa and K. Matsubara, 1996. cDNA cloning and expression of a novel adipose specific collagen-like factore, apM1 (Adipose most abundant gene transcript 1). Bioch. Biophy. Res. Commun., 221: 286-289.

Mohebi, H., G.E. Talebi and F. Rahbarizadeh, 2009. Effect of intensity training on plasma adiponectin concentration in male rat. Olympic, 16: 71-78.

Mohhebat, H., E. Talebi Garekani, M. Hedayati and R. Fathi, 2009. Effects of exercise training on high molecular weight Adiponectin in healthy male rat. Iranian J. Endocrinol. Metab., 11: 315-321.

Ounis, O.B., M. Elloumi, M. Amri, A. Zbidi, Z. Tabka and G. Lac, 2008. Impact of diet, exercise and diet combined with exercise programs on plasma lipoprotein and adiponectin levels in obese girls. J. Sports Sci. Med., 7: 437-445.

Rumi, T., M. Kanehisa and N. Kunio, 2005. Association between lifestyle factors and plasma adiponectin levels in Japanese men. Lipids Health Dis., Vol. 4 10.1186/1476-511X-4-27

Santosa, S., I. Demonty, A.H. Lichtenstein, K. Cianflone and P.J.H. Jones, 2007. An investigation of hormone and lipid associations after weight loss in women. J. Am. College Nutr., 26: 250-258.

Scherer, P.E., S. Williams, M. Fgliano, G. Baldini and H.F. Lodish, 1995. A novel serum protein similar to C1q, produced exclusively in adipocytes. J. Biol. Chem., 27: 26746-26749.

Varady, K.A., S. Bhutani, E.C. Church and S.A. Phillips, 2010. Adipokine responses to acute resistance exercise in trained and untrained men. Med. Sci. Sports Exercise, 42: 456-462.

Yatagai, T., Y. Nishida, S. Nagasaka, T. Nakamura and K. Tokuyama *et al*., 2003. Relationship between exercise training-induced increase in insulin sensitivity and Adiponectinemia in healthy men. Endocrine J., 50: 233-238.

Yoshida, H., T. Ishikawa, M. Suto, H. Kurosawa and Y. Hirowatari *et al*., 2010. Effects of supervised aerobic exercise training on serum Adiponectin and parameters of lipid and glucose metabolism in subjects with moderate dyslipidemia. J. Atherosclerosis Thrombosis, 17: 1160-1166.

Zeng, Q., L. Fu, K. Takekoshi, Y. Kawakami and K. Isobe, 2007. Effects of short-term exercise on adiponectin and adiponectin receptor levels in rats. J. Atheroscler Thromb, 14: 261-265.