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

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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 kDa 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; Yatajai 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 Sprague 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.

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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 (Orgenium, 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 (8.62 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.

![Graphs showing adiponectin, LDL, and HDL levels](image)

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 (Mohbebat 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 (Mohbebat 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 (Mohbebat 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 skiers, 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; Højbjerg 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 (Oumis 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 (Santos 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.

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