

## Original Article

**Acute Effects of Aerobic and Combined Exercise on Serum Lipid Profile in Type II Diabetic Females**\*Zahra Hojjati<sup>1</sup> Sara Shamsavari<sup>2</sup>

1- Department of Physical Education, School of Human sciences, Rasht Branch, Islamic Azad University, Rasht, Iran  
2- Health Center of Rasht City, Family Health Unit, Rasht, Iran

\*z\_hoj@yahoo.com

(Received: 26 Jul 2014; Revised: 7 Dec 2014; Accepted: 19 May 2015)

**Abstract**

**Background and purpose:** This study compares the efficacy and durability of an acute aerobic and combined exercise on lipid profile levels of diabetic females.

**Materials and Methods:** In a semi-experimental design, 21 females with Type 2 diabetes (age:  $43 \pm 4.92$  years and body mass index  $29.57 \pm 4.17$ ) voluntarily participated in study and randomly divided into three: Aerobic exercise, combined exercise and control groups. Aerobic exercise was conducted for 45 min running on the treadmill at 60-70% of maximum heart rate. Combined exercise was conducted for 20 min of running like aerobic group and 10 the stationary resistance exercise for 3 sets of 10 reps. The control group did not perform any exercises. Variables were measured in four stages: Pre-exercise, immediately, 24 and 48 h after exercise at the same time after overnight fasting. Repeated measures ANOVA was used to determine changes within group.

**Results:** The results showed that exercises created significant changes in a triglyceride. In an aerobic group, triglyceride decreased 24 h after exercise compare to before it and in the combined group, increased 48 h after exercise compare to 24 h after it ( $P \leq 0.05$ ). Significant changes in low density lipoprotein-cholesterol and high density lipoprotein-cholesterol rate was not observed within two groups ( $P > 0.05$ ). Also, in combined and aerobic exercise groups, there was a significant decrease in serum cholesterol after in comparison to before it ( $P \leq 0.05$ ).

**Conclusion:** The findings showed that a session of aerobic or combined exercise caused significant acute changes in lipid profile.

[\*Hojjati Z, Shamsavari S. Acute effects of aerobic and combined exercise on serum lipid profile in Type II diabetic females. *IJHS* 2015; 3(2): 31-37] <http://jhs.mazums.ac.ir>

**Key words:** Exercises, Type 2 Diabetes, Lipid Profile

## 1. Introduction

Diabetes as the most common diseases proceeds from metabolism disorders are on the increase in recent years (1) So that from 1995 to 2025 the population will have been affected by diabetes increase in 22% (2). From the beginning of the 21 century, 150 million people in the world and 2 million people in Iran are suffered from it (3). An impressive progress in global technology physical activity and mobility are reduced extensively, and prevalence of chronic diseases like diabetes are increased (4).

Diabetes, like other chronic diseases, in addition to high mortality, may be due to some like social and economic problems. Other problems of diabetes are being inclusive in patient's physiological function of the body (5). Diabetes intensifies the rate of heart disease and is accompanied by macrovascular and microvascular with the symptoms such as retinopathy, autonomic and peripheral neuropathy, peripheral vascular disease, atherosclerosis, cardiovascular problems, high blood pressure (6,7).

Such as diet adjustment, exercise is a specific treatment for diabetes (8,9). Some benefits of exercise are could be useful for cardiovascular disease by favorable changes in blood lipid profile (total cholesterol (TC), triglycerides, high-density lipoprotein [HDL] and low density lipoprotein [LDL]), improved blood pressure, increased insulin sensitivity, weight loss, maintaining optimal weight, glycemic control and improved quality of life (6,8,9). The mechanism of acute effects of exercise on blood lipid profile are not well known and there are few studies that have investigated different types of exercises in the same population (10), while the long-term effects of exercise training on lipid profile are well known (11,12). Nevertheless, in contrast to endurance training, relatively little information exists on the effects of combined (endurance and resistance) training on lipid profile (13). Joseph et al. reported that acute

exercise reduced triglyceride levels after exercise, but TC, LDL-cholesterol (LDL-C) and HDL-cholesterol (HDL-C) have not changed immediately after resistance aerobic exercise (14). Some study in resistance exercise, reported increased concentration of -LDL-C and reduced HDL-C (15,16). Another study has been reported an increase in HDL-C after a period of acute low-intensity aerobic exercise (10). According to conflicting results of some studies about the effect of acute exercise on serum lipids, enough studies has not been done regarding to compare aerobic and combined exercise on serum lipid profile concentrations. Perhaps some of the reasons differences in the results of previous experimental would be involved inclusive characteristics of subjects (gender, genetic predisposition), lack of control, subjects feeding, differences in experimental design including various training programs (duration, intensity and type of exercise), the population of subjects and the relative lack of information about each type of energy absorption during exercise (17). This study, by controlling the subjects feeding 3 days before and after training, is come up with. We examine the effects of two types of exercise (aerobic and combined) on lipid levels in diabetic women 30-50 years.

## 2. Materials and Methods

In a semi-experimental trial with 21 Type 2 diabetic females (non-history of regular exercise for at least in recent 6 months), mean (age:  $43 \pm 4.92$  years and body mass index  $29.57 \pm 4.17$ ), participants were voluntary selected from 54 diabetic women who conferred to Katesar (Guilan province-Rasht city, Iran) health center in 2013 fall. Participants randomly divided into three: aerobic exercise, combined exercise and control groups. Participants were informed of the benefits and risks of the study and completed a consent form before starting

work. Subjects attended the gym on separate occasions for exercise familiarization, pre-experimental testing, proper lifting techniques and how to use the treadmill. The subjects were trained to determine one repetition maximum (1RM). For pretest sampling after an overnight fast (12 h) blood was sampled at 9 A.M. participants attended the gym to perform their activity at 8 A.M in fasting conditions on the exercise day. Second blood samples were obtained immediately after exercise and after that the same breakfast (550 kcal) was taken. 24 h and 48 h after exercise blood samples obtained in the same fasting state and temperature.

Subjects were fed isocaloric throughout the experimental period (3 days before and after practice). The related information to subject's diet was recorded by subjects via 24 h dietary recall questionnaire in 3 days (two 1<sup>st</sup> days and the last day of the week) (17). In order to analysis the data, at first, consumed food converted to gram then related information to diet were analyzed, and macronutrients were determined.

In the day program, subjects received a standard diet dietary reference intakes (15). Basal metabolic energy requirements based on age, sex, weight, apply the following formula to calculate the activity factor, the total daily energy requirements were calculated (18).

$$REE = 655.1 + 9.6 \times \text{body weight (kg)} + 1.8 \times \text{height (cm)} - 4.7 \times \text{age}$$

Subjects were asked to keep their diet which has been recommended till last blood sampling (5). Combined and aerobic exercise sessions were included general warm-up (10 min), specialize warm up (3-5 min), exercise and cool down (45 min) which were performed on the same day for two groups. Aerobic exercise included running on a treadmill for 45 min (in 2 sets of 20 and 25 min) in 60-70% of maximum heart rate, and combined exercise included of aerobic exercise on a treadmill for 20 min at 60-70% of maximum heart rate and resistance training in

70% of 1RM with 10 repetitions of each movement for 3 sets with 30 s rest between stations and 2 min between each round was considered. Resistance training consisted of 10 exercises in a circle manner. Stations were as leg flexion, leg extension, leg press, squat, stretch underarm, chest press, cross motion with dumbbells, biceps, triceps, and sit-up (15).

Immediately after blood sampling, serum separated by centrifugation 3000 rpm and it was maintained at  $-70^{\circ}\text{C}$  until the last testing. Variables include triglycerides, TC, LDL-C and HDL-C. Pars enzymatic test kits were used for analysis of serum lipids and lipoproteins via 550 cibacorning machine.

The descriptive statistics were used to determine the mean and standard deviation of variables. Repeated measures ANOVA were used to determine changes within group. P values for significant changes were equal or less than 0.05.

### 3. Results

Participants' characteristics were shown in table 1. Kolmogorov-Smirnoff test showed that the entire variable distributes were normal. Triglyceride of combined and aerobic exercise and control group are presented in figure 1. Results showed that a single bout of acute aerobic and combined exercise created significant changes in triglyceride levels ( $P \leq 0.05$ ). Triglyceride in aerobic group reduced 24 h after exercise compared to before exercise. Triglyceride increased 48 h after exercise compared to 24 h after exercise in combined group. No significant changes were observed in the control group ( $P > 0.05$ ).

The acute effects of combined and aerobic exercise and control group on cholesterol are presented in figure 2.

Combined and aerobic exercise was created a significant decrease in cholesterol levels 24 h after exercise compared with immediately after exercise ( $P \leq 0.05$ ). No significant

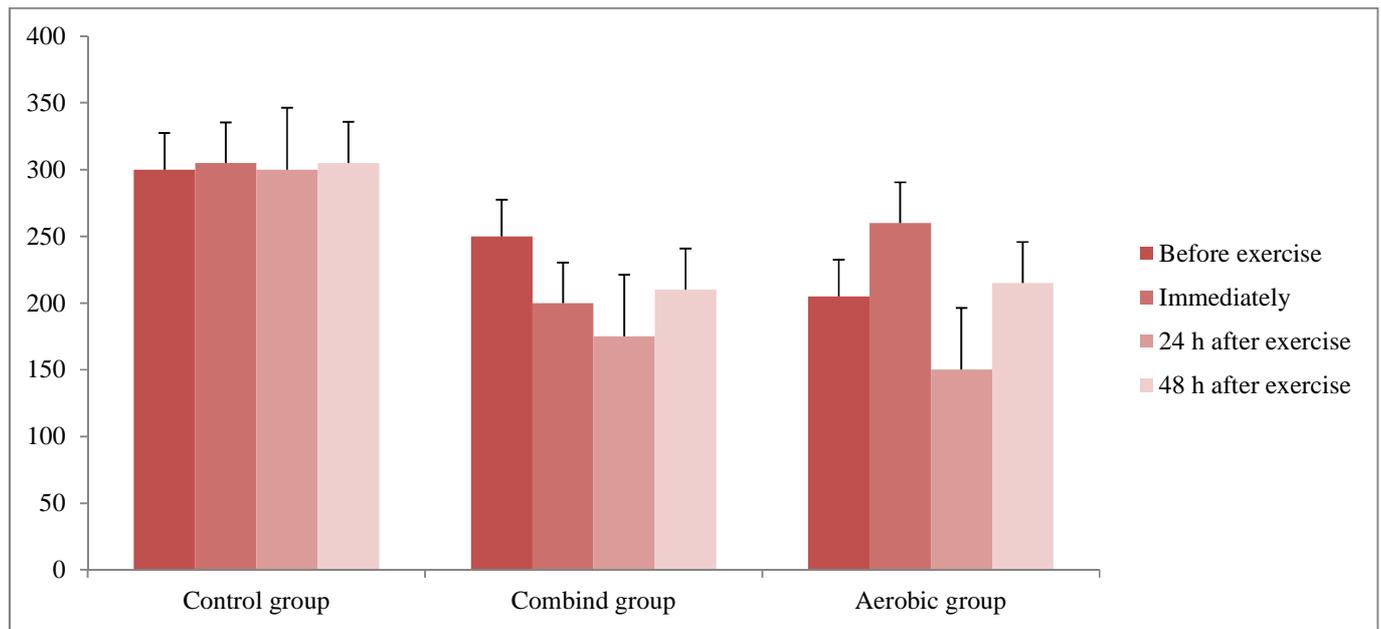
changes in HDL-C and LDL-C levels were observed within three groups ( $P > 0.05$ ). The

changes of LDL-C and HDL-C are presented in table 2.

**Table 1.** Participants' characteristics (Mean  $\pm$  SD)

Group	Age (years)	Weight (kg)	Height (cm)	BMI (kg/m <sup>2</sup> )
Control	42.00 $\pm$ 5.12	71.15 $\pm$ 11.78	154.71 $\pm$ 5.45	29.57 $\pm$ 4.17
Aerobic	43.00 $\pm$ 4.89	73.23 $\pm$ 10.63	155.57 $\pm$ 5.16	29.34 $\pm$ 5.25
Combined	42.00 $\pm$ 6.22	71.95 $\pm$ 11.56	154.87 $\pm$ 6.24	29.78 $\pm$ 4.46

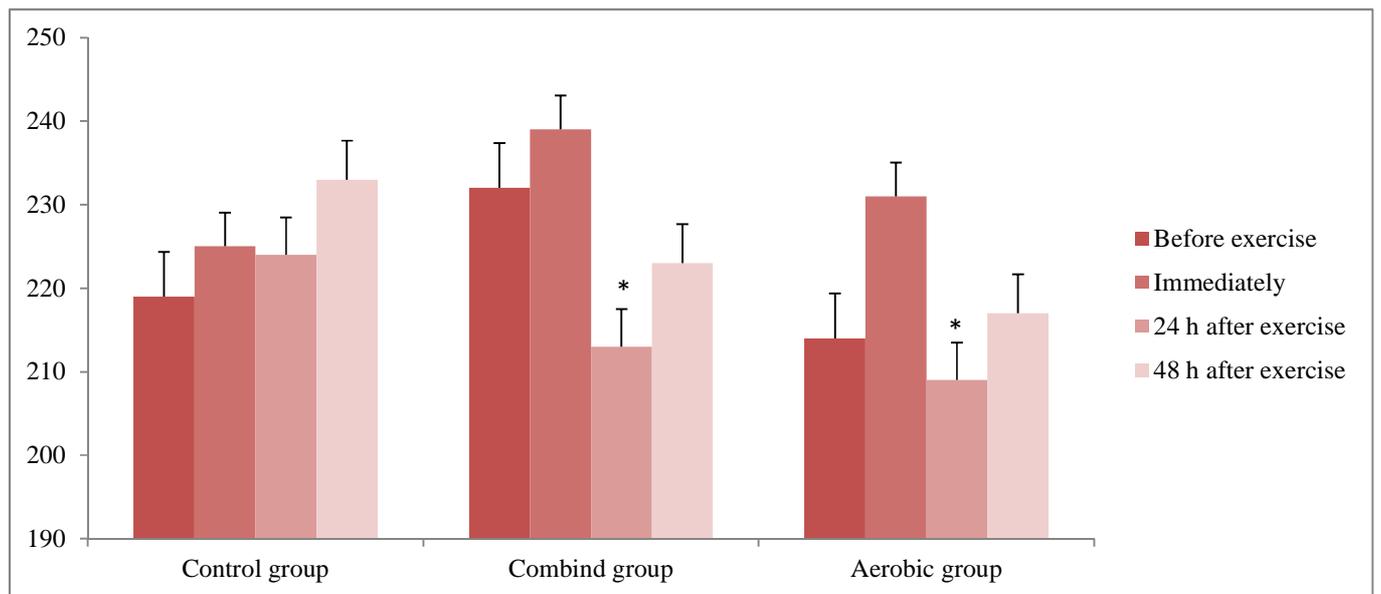
SD: Standard deviation, BMI: Body mass index



**Figure 1.** Serum triglyceride (mg/dl) in combined, aerobic and control groups,

\*Significant decrease compared to pre-exercise within group ( $P \leq 0.05$ )

\*\*Significant increase compared with 24 h after exercise within group ( $P \leq 0.05$ )



**Figure 2.** Serum cholesterol in combined, aerobic and control groups

\*Significant decrease compared with immediately after exercise within group ( $P \leq 0.05$ )

**Table 2.** LDL-C and HDL-C in combined, aerobic exercise and control groups

Variables	Time	Control	F	Sig	Aerobic	F	Sig	Combined	F	Sig
LDL-C (mg/dl)	Before	118±40	2.97	0.06	132 ± 26	3.91	0.06	144 ± 38	2.53	0.15
	Immediately	117 ± 40			141 ± 24			149 ± 46		
	24 h after	121 ± 37			131 ± 25			137 ± 43		
	48 h after	123 ± 40			131 ± 25			146 ± 37		
HDL-C (mg/dl)	Before	54 ± 11	0.85	0.48	48±6	0.88	0.50	47 ± 6	1.22	0.33
	Immediately	52 ± 11			51 ± 10			50 ± 7		
	24 h after	54 ± 10			49 ± 5			48 ± 6		
	48 h after	53 ± 12			48 ± 7			47 ± 6		

LDL-C: Low density lipoprotein-cholesterol, HDL-C: High density lipoprotein-cholesterol

#### 4. Discussion

Exercise has an obvious and significant effect on prevention and treatment of Type 2 diabetes (1). Long-term effects of continuous exercise have been also known on lipid profile (9,10), but the short-term effects of exercise in this regard are too little and contradictory. Compared to aerobic exercise there are less information about the effects of combined and resistance exercise on lipid profile (11). It has been reported that, desirably, resistance training can reduce the concentrations of LDL-C and increase the HDL-C (13,14).

The results of this study showed that a single bout of exercise can change the short-term response to lipid profile. Triglyceride concentration in the combination exercise group decreased 24 h after exercise compare to before exercise, while in aerobic exercise triglyceride concentration has increased 48 h after exercise in compare to 24 h after it. One of limitation of our study is that we monitored the participant diet in exercise days but the diet was prescribed in other days and did not accurately control. A similar reduction that investigate the acute effect of aerobic and resistance exercise on sedentary males has been observed (12) and it can be seen in Subasi et al. studies. In contrast to other studies, no significant changes in blood triglyceride rate after a period of acute aerobic exercise reported (8).

Reduction in TC concentration is reported, in a single bout of aerobic and combined exercise in both groups in 24 h after exercise

in compare to immediately after it. This reduction was greater in the combined group. Some studies showed significant reduction in TC in subjects who were trained with short-term exercise (19,20). The slight increase in TC concentration after 24 h on a bicycle ergometer exercise in sedentary men has been reported, although this increase was not significant (13).

Although muscle needs less fat compare to carbohydrates during exercise but oxidation of free fatty acids is very important for performing endurance activities (21,22). Catecholamine, growth hormone, and cortisol rise in the bloodstream, but insulin level reduces. The consequences of these occurrences are increased glycogenolysis and glycolysis in muscle and liver, lipolysis in adipose tissue and muscles, and gluconeogenesis in liver and also increased protein breakdown in muscle and liver. The pure effect of this process is that the amount of glucose in the blood remains relatively constant (at least for 60-90 min), fatty acids, glycerol, ketones and also the amino acids increase in the blood during endurance exercise. These are energy sources that are used by the muscle (23). It is supposed that because of increased energy consumption, the exercise volume and/or the exercise intensity lead to reduction in TG level and also more significant reduction in TC level after exercise in combined group compared to aerobic group.

In the present study, there were no significant changes in the levels of HDL-C

and LDL-C. In some studies that examined “the effect of acute aerobic and resistance exercise on sedentary students” no significant changes in HDL-C and LDL-C rate reported (12), but other studies has been reported increased HDL-C after low intensity aerobic exercise (8). One reason for increased HDL-C is increasing the activity of the lipoprotein lipase enzyme and decreasing the activity of hepatic lipase enzyme. HDL-C level was rose by lipoprotein lipase activity, that is a key enzyme for converting VLDL-C to HDL-C. The storage and synthesis of hepatic triglycerides and LDL-C is going to decrease by hepatic lipase activity reduction. In this context, it is likely that other mechanisms, such as decreased insulin sensitivity and lipoprotein changes in lipid levels can be mentioned (24,25). It should be considered that continuous activity can increase the blood volume and an exercise session can decrease it. Therefore, in the primary steps of the exercise, by increasing the blood pressure a certain amount of plasma enter into the interstitial water and blood concentration has increased up to 20% in some capillaries in the first 10 min of the exercise. It is possible that no changes in HDL-C even with reduction plasma volume lead to some changes in concentration of serum lipids.

According to the results of this study, however, the immediate effects of physical activity are limited but, cumulative effects of small changes in physical activity are possible, and useful outcomes can be achieved in a long time. Also, by considering the tolerance and tendency of the most people in performing the resistance exercise in comparison with aerobic exercise, the combined effect of two types of resistance and endurance should be considered. It seems that if the present study continuously carries out, lipid profile significantly improve, it is possible that these responses change to adaptability to be a way for preventing diabetes chronic complications.

### Acknowledgement

The authors would like to thank the staff of Katesar Health Center and all participants for their cooperation in this study.

### References

1. Colberg SR, Sigal RJ, Fernhall B, Regensteiner JG, Blissmer BJ, Rubin RR, et al. Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement executive summary. *Diabetes Care* 2010; 33(12): 2692-6.
2. Delavari A, Mahdavi A, Norozinejad A, Yarahmadi Sh, Gouya MM. tehran, Iran: Seda Publications; 2005. p. 11-29. [In Persian]
3. Razaati M, Ghotbi M, Ahmadnia H. Prevention and treatment of diseases, non-communicable disease surveillance system. 1st ed. Sepidbarg Publication; 2008. p. 12-8. [In Persian]
4. Colberg Sh. Diabetic athlete's handbook. Champaign, IL: Human Kinetics; 2008.
5. Dimitropoulos G, Tahrani AA, Stevens MJ. Cardiac autonomic neuropathy in patients with diabetes mellitus. *World J Diabetes* 2014; 5(1): 17-39.
6. Roberts CK, Barnard RJ. Effects of exercise and diet on chronic disease. *J Appl Physiol* 2005; 98(1): 3-30.
7. Faraji H, Bab L, Ardeshiri H. Effects of resistance exercise intensity and volume on postexercise hypotensive responses. *Brazilian Journal of Biomotricity* 2010; 4(1): 65-73.
8. Hernandez-Torres RP, Ramos-Jimenez A, Torres-Duran PV, Romero-Gonzalez J, Mascher D, Posadas-Romero C, et al. Effects of single sessions of low-intensity continuous and moderate-intensity intermittent exercise on blood lipids in the same endurance runners. *J Sci Med Sport* 2009; 12(2): 323-31.
9. Elmahgoub SM, Lambers S, Stegen S, Van Laethem C, Cambier D, Calders P. The influence of combined exercise training on indices of obesity, physical fitness and lipid profile in overweight and obese adolescents with mental retardation. *Eur J Pediatr* 2009; 168(11): 1327-33.

10. Sabbaghian Rad L, Gholami M. Impact of exercise training and/or diet on the lipoprotein–lipid profiles in young overweight women. *Br J Sports Med* 2010; 44(i20).
11. Marques E, Carvalho J, Soares JM, Marques F, Mota J. Effects of resistance and multicomponent exercise on lipid profiles of older women. *Maturitas* 2009; 63(1): 84-8.
12. Subasi SS, Gelecek N, Ozdemir N, Ormen M. Influences of acute resistance and aerobic exercises on plasma homocysteine level and lipid profiles. *Turkish Journal of Biochemistry* 2009; 34(1): 9-14. [In Persian]
13. Argani N, Sharifi G, Golshahi J. Comparison of the effect of different intensity exercise on a bicycle ergometer on postprandial lipidemia in type II diabetic patients. *ARYA Atheroscler* 2014; 10(3): 147-53.
14. Joseph LJ, Davey SL, Evans WJ, Campbell WW. Differential effect of resistance training on the body composition and lipoprotein-lipid profile in older men and women. *Metabolism* 1999; 48(11): 1474-80.
15. Azarbayjani MA, Abedi B. Comparison of aerobic, resistance and concurrent exercise on lipid profiles and adiponectin in sedentary men. *Knowledge and Health* 2012; 7(1): 32-8. [In Persian]
16. Whaley MH, Brubaker PH, Otto RM, Armstrong LE. *ACSM's guidelines for exercise testing and prescription*. Philadelphia, PA: Lippincott Williams & Wilkins; 2006.
17. Naude CE, Schoonees A, Senekal M, Young T, Garner P, Volmink J. Low carbohydrate versus isoenergetic balanced diets for reducing weight and cardiovascular risk: a systematic review and meta-analysis. *PLoS One* 2014; 9(7): e100652.
18. Hojjati Z. *Nutrition*. 1<sup>st</sup> ed. Rasht, Iran: Dehsara Publication; 2012. p. 45-60. [In Persian]
19. Paoli A, Pacelli QF, Moro T, Marcolin G, Neri M, Battaglia G, et al. Effects of high-intensity circuit training, low-intensity circuit training and endurance training on blood pressure and lipoproteins in middle-aged overweight men. *Lipids Health Dis* 2013; 12: 131.
20. Gordon LA, Morrison EY, McGrowder DA, Young R, Fraser YT, Zamora EM, et al. Effect of exercise therapy on lipid profile and oxidative stress indicators in patients with type 2 diabetes. *BMC Complement Altern Med* 2008; 8: 21.
21. Chapman MJ, Ginsberg HN, Amarenco P, Andreotti F, Boren J, Catapano AL, et al. Triglyceride-rich lipoproteins and high-density lipoprotein cholesterol in patients at high risk of cardiovascular disease: evidence and guidance for management. *Eur Heart J* 2011; 32(11): 1345-61.
22. Daly RM, Miller EG, Dunstan DW, Kerr DA, Solah V, Menzies D, et al. The effects of progressive resistance training combined with a whey-protein drink and vitamin D supplementation on glycaemic control, body composition and cardiometabolic risk factors in older adults with type 2 diabetes: study protocol for a randomized controlled trial. *Trials* 2014; 15(431).
23. MacLaren D, Morton J. *Biochemistry for sport and exercise metabolism*. 1<sup>st</sup> ed. London, UK: Wiley; 2011.p. 185-7.
24. Esteghamati A, Hasbi M, Halabchi F. Exercise prescription for patients with type 2 diabetes. *Iran j Diabetes Metab* 2015; 7(3): 251-65. [In Persian]
25. Jensen TE, Richter EA. Regulation of glucose and glycogen metabolism during and after exercise. *J Physiol* 2012; 590(Pt 5): 1069-76.