Effect of four weeks concurrent training (aerobics-resistance) and caffeine supplementation on body composition and lipid profile in overweight girls

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Abstract

Introduction: performing exercise and applying of food strategies is one of the healthy and low risk approaches to overweight treatment. In this case, some researchers believe in that lipotropic supplement such as caffeine with or without endurance and resistance physical exercise may cause to improvement of cardiovascular risk. However, there is not comprehensive studies in the case of effectiveness of concurrent training of aerobics and resistance training and caffeine supplementation. Anyway, due to the remained contradictions and ambiguities, the present study conducted in order to determine the effectiveness of four weeks concurrent training with and without caffeine supplementation on body composition and lipid profile indexes in the overweight girls.

Methodology: 20 overweight volunteer girls which are students in University of Tabriz (20-30 years old, BMI=24.90-30) participated in this random, double-blind study. Subjects were divided to two groups (n=10) of (concurrent training + caffeine supplementation) and (concurrent training + placebo). Primary measurements, blood sampling and needed coordination were conducted in order to not using drug and performing physical exercise, ten days before starting training protocol and supplementation. 24 hours after latest day of concurrent training of aerobics and resistance training and supplementation and second blood sampling were conducted. All data expressed as mean ± SD at significance level of less than 0.05.

Results: the findings indicated, there was a significant decrease in waist Circumference and fat percentage in both groups after four weeks of concurrent training (α< 0.05). There was significantly improvement on the waist Circumference, fat percentage, TC after concurrent training (aerobics-resistance training) with caffeine supplementation (α< 0.05). In contrast, in the serum triglyceride, LDL and HDL, there was no significantly changes after training and caffeine supplementation (α>0.05). But there was not significantly difference between caffeine and placebo groups (α>0.05).

Conclusion: according to the findings it can be concluded that the concurrent training (aerobic-resistance training) alone and in the interaction with caffeine supplementation improves body composition indices and cardiovascular disease risk factors.

Key words: Concurrent Training, Caffeine, body composition, lipid profile

Introduction

Unsuitable diet and sedentary lifestyle are the most important causes of overweight, obesity and predisposing factors for non-communicable diseases such as diabetes, hypertension, hyperlipidemia and cardiovascular disease (Cheraghpour, 2013). So that, deaths from the cardiovascular diseases among obese men and women are three times higher than other people. Also, deaths from the cardiovascular diseases in men and women, respectively 21 and 28 percent
are attributed to overweight and obesity (Suzuki, Jayasena, & Bloom, 2012). Some researchers believe that the central distribution of fat is more important, and abdominal obesity with accumulation of fat in the abdomen as an important risk factor is associated with changes in blood’s lipid profile (Gharipour, Mohammadifard, Asgary, & Nadert). Triglyceride (TG), total cholesterol (TC), and concentrations of HDL and LDL, are the blood lipid profile’s indicators; which by them can be predicted cardiovascular diseases in the future (Asad, 2013; Gharipour, Midgley, & Bentley, 2009).

High-density lipoproteins (HDL), which had the lowest amount of cholesterol; carry the cholesterol from the vessel wall to the liver, for conversion to the biliary salts. Low-density lipoproteins (LDL), which are naturally carry 60% to 80% of plasma’s cholesterol and have a high tendency for sticking to the vessel’s wall. Cholesterol deposition in the walls of arteries stimulate the growth of smooth muscle cells in the walls of arteries below the sediments and absorb the fibroblasts to that area (which speeds-up blood clotting); if this action is done in the coronary arteries that afferent blood to the heart tissue, Possibly prevents from reaching sufficient oxygen to the heart tissue, which leads myocardial infarction or necrosis in the area of the heart. Also, the cholesterol sedimentation in the arterial wall, directly linked with amount of calorie intake, especially in conditions of positive calorie balance or nutrition with high fat and cholesterol percentage (Asad, 2013).

However, since body weight is regulated by a collection of homeostasis mechanisms, changes in energy homeostasis could have several reasons such as: incorrect lifestyle, high energy intake and absence physical activity; which Leads to obesity. Generally, it can be said obesity possibly is a condition that the absorbed energy is always more than the energy consumption (Asad, 2013; Suzuki et al., 2012).

However, to control and treatment of obesity and its consequences different approaches such as: diet, fat burner supplements, medication, surgery and participation in physical activities is recommended by the researchers and professionals (Su et al., 2013; Weiss & Kaufman, 2008). For example, some researchers believe that consumption of weight loss supplements such as caffeine, alone and in interaction with physical exercise may leads to some favorable changes (Nagao, Hase, & Tokimitsu, 2007; Su et al., 2013). Because caffeine consumption increases the oxidation of fatty acids and energy expenditure during aerobic exercise (jamali, 2012).

On the other hand, regular program of exercise as a preventive and curative interventions approaches in addition to the prevention the breakdown of protein, regulates body’s carbohydrates and fats metabolism (Nourshahi). In this case, some studies have suggested performing both aerobic and resistance exercise is efficient to increase lean body mass and decreased fat mass (Lee, Kim, Seo, Kim, & Yoon, 2015). So that, endurance and resistance training in different forms as the concurrent training exercises as a training method has attracted the researcher’s attention (Asad, 2013). However widespread benefits of combining strength and endurance training, there is considerable evidence that suggests concurrent trainings better than resistance training alone, provides the development muscle mass, strength and power (Fythe, Bishop, & Stepto, 2014).

Effects of the concurrent training on many various aspects of biological in animal and human studies have been determined, but in relation to combination the interact between exercises and fat burner supplements such as caffeine supplementation the comprehensive studies are not available; although in some studies beneficial effects of caffeine alone on many indexes the health and physical performance are discussed. For example, Habibi Asl et al. (2013) showed different amounts of caffeine (10, 8 and 16 mg per kg body weight) had a significant weight loss (Asl, Vaez, Imankhah, & Hamidi, 2014). Whereas, Graham et al (2000) reported; despite the caffeine stimulates the sympathetic nervous system, There were no changes in the metabolism of fats and carbohydrates (Graham, Helge, MacLean, Kiens, & Richter, 2000).

However, it is necessary with using human and animal designs answered in some ambiguity in relation to the interactive effects of exercise and caffeine supplementation (Graham et al., 2000).

Materials and methods

The present study was conducted as a semi-experimental, double-blind research with repeated measurements; after receiving the approval for ethical considerations of the research from Tabriz University of Medical Sciences (The code: TBZMED.REC.1394.812).

The statistical population consisted of female students with overweight, aged between 20 to 30 years from University of Tabriz, which had no history of participation in regular exercise for the last six months. According to the previous studies and considering alpha=0.05 and beta=0.0, the sample size for each group was determined as seven. And in order to choose the samples, some announcements were distributed on campus and dormitory of Tabriz University. After explaining and introducing the goals and methods of the research to volunteers, 20 healthy girls aged between 20 to 30, with overweight and obesity were selected based on some geomorphologic and hematological parameters to participate in the
study. Participant were randomly assigned to two homogeneous groups of (concurrent training + caffeine supplementation) and (concurrent training + Maltodextrin Placebo) through matching method. Ten days before the start of research, topic and objectives of the study were explained to all volunteers in written form and verbally by researcher. All steps of the experiment process was conducted under the identical standard conditions (Humidity: 50%-55%; temperature 26-24 ℃); with three sessions per week and considering the menstruation cycle for each participant. The sessions were held in a sport hall with the same air conditioning and the lighting rate. Before collecting blood samples in every phase, the participants were asked to avoid heavy works and to abstain the consumption of fat-burning supplements and anti-inflammatory drugs such as Ibuprofen, Ginger and etc.

The training protocol of the present study consisted of the subject’s participation in a four-week training program, including 12 session one and a half hour concurrent training combination of aerobics exercise (progressive intensity 65%-85% reserve heart rate) plus resistance training exercises (leg press, lat pull forward, flat on the bench with a barbell bench press, leg curl at 75%-70% of one repetition maximum) with perceived exertion of 13-17]. 24 hours before the first session, Subjects were asked to avoid performing extra exercise. To estimate the training intensity using Karvonen formula, the resting heart rate of subjects were recorded for one minute, after spending 10 minutes of rest in the sitting position, using the Polar heart rate monitor. For each subject, 65% - 85% reserve heart rate was calculated using the Karvonen formula.

All participants performed stretching, suppleness and Aerobics simple chain execution for 20-10 minutes respectively to warm up and cool down, before and after each training session (Warming up with slow jogging, stretching and aerobics simple chain execution with perceived exertion of (11 to 13) and cooling down with light stretching, suppleness and Aerobics simple chain execution equivalent to half of the original practice with perceived exertion of (10-8).

In the main trunk of exercises, Participants started to run Aerobics chains. In the beginning of each aerobics chain execution, the participants performed it for two minutes until they reached the target heart rate and then they had five minutes of active rest to recovery. At each session, the start of performing the movements was started with 65% reserve heart rate and eventually reached to 85% reserve heart rate. Also, during the resting intervals between the chains, participants performed the active recovery. Participants were instructed to find the pulse of the carotid artery in the neck and wrist using the index and middle fingers and to count the beats for 10 seconds (Pulse location was marked on the skin) and participants announced the rate to researcher in times during the training. After half hour of performing the aerobics exercise, and active resting for the following five minutes, any of the subjects started their resistance training. Resistance training included exercises (leg press, lat pull forward, flat on the bench with a barbell bench press, leg curl) with the intensity of 70%-75% of one repetition maximum (1RM). It performed in three sets of 10 repetitions with 90 seconds resting intervals, while resting between exercises was 2 minutes.

Two week before starting the research protocol, all participants attended in the sport hall to get familiarized with the aerobic training chain movements and the devices and methods of doing any of the motions. It was also aimed to have participants achieving the desired intensity of aerobic exercise as well as setting a maximum repetition and avoiding the influence of delayed onset muscle soreness (DOMS) resulting from resistance training.

To increase the intensity of resistance training, the first week of preparation was done with 50% of one repetition maximum intensity, the second week, with 60% of one repetition maximum intensity and finally ended up to 70% of one repetition maximum intensity till the beginning of the research protocol. The caffeine powder of Merck Co. (made in Germany) and licensed by the Department of Health, was purchased (with registration number 0250.02584.1). Then, in the exercise physiology laboratory were prepared as 500 mg capsules using digital scale. Capsules were filled with the dose of 5 mg per kilogram of subject’s body weight. Dextrose placebo capsules were supplied by one of the accredited centers of production and distribution of food supplements. And it was packed into capsules, with amount of 5 mg per kg of body weight of the subjects. During the one month period, each participant was daily given one capsule of caffeine or dextrose. (Half an hour after breakfast with a glass of water) Participants were blind to the content of the capsule. The amount of caffeine in this study was determined as 5 mg per kg of body weight of the subjects based on previous studies and a specialist prescription to improve anthropometric indices, lipid profile or to influence the biochemical markers along with combined training. During the intervention, we made phone calls to participants on a daily basis, for asking questions about any possible unwanted side effects, as well as for recommending the regular intake of the capsules. To measure the height, participants stood on the stadiometer without shoes and socks, tightened the heels, hips and back to the stadiometer rod, and the researcher measured their height.
Weight measurement for each participant was done using analog scales (Yagamy Japan) without shoes and with minimal clothing. BMI was calculated using the following equation:

$$\text{BMI} = \frac{\text{Body mass (kg)}}{\text{Height (m)^2}}$$

Body fat percentage were measured using calipers RH.15.9LB (made in Germany) and applying the standard three-site method (triceps, thigh, above the iliac) on the right side. Then the calculations were made using Jackson and Pollock formula for females body fat percentage, as follows:

$$\text{BF} = \frac{0.000023 \times (\Sigma X_{1,2,3})^2 + (0.0001392 \times \text{age})}{1.0994921 - (0.0009929 \times (\Sigma X_{1,2,3})))}$$

The waist circumference was measured around the maximal abdominal diameter between waist and upper hip bone with a tape measure (0.5 meter).

To determine a repetition maximum, participants were asked to lift the maximum weight to failure, and then the used weight and the repetition number of moving were replaced in BRZYCKI formula (1993) for less than 10 repetitions with weight.

$$1 \text{ RM} = \frac{\text{weight used for repetition}}{1.0278 \times (0.0278 \times \text{number of repetitions with weight})}$$

Blood samples were collected in two phases: before and 24 hours after the last round of training protocol and supplementation. Before each blood sampling procedure, participants rested a few minutes in the sitting position and then 5 cc of blood were taken from the brachial vein and poured in the tubes containing EDTA as an anticoagulant and were centrifuged immediately for 8 minutes at 3,000 rpm using a centrifuge machine. The obtained serum were kept in separate tubes at -20°C for upcoming tests.

Levels of TG, TC, HDL were measured using a Pars Azmoon kit (Pars Azmoon Co., Tehran, Iran), and a Hitachi 902 autoanalyser (Hitachi Ltd., Germany). The amount of LDL was calculated based on TG, TC and HDL values using Friedewald formula.

$$\text{LD}=\text{TC} - (\text{HDL} + \text{TG}/5)$$

Data homogeneity was tested using the Kolmogorov-Smirnov test and t-test. Regarding the non-normality of the data, nonparametric tests of Mann-Whitney and Wilcoxon were applied using SPSS software for Windows version 22. The significance level was set at $P < 0.05$.

**Results**

Initial information of participants including age, height, weight, body mass index and body fat percentage is presented in Table (1) for both groups.

<table>
<thead>
<tr>
<th>Index</th>
<th>Groups</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>Caffeine + concurrent training</td>
<td>4.26±24.25</td>
</tr>
<tr>
<td></td>
<td>Concurrent training + placebo</td>
<td>1.30±24.21</td>
</tr>
<tr>
<td>Height (m)</td>
<td>Caffeine + concurrent training</td>
<td>2.59±161.75</td>
</tr>
<tr>
<td></td>
<td>Concurrent training + placebo</td>
<td>1.22±157.00</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>Caffeine + concurrent training</td>
<td>7.68±75.38</td>
</tr>
<tr>
<td></td>
<td>Concurrent training + placebo</td>
<td>5.46±68.88</td>
</tr>
<tr>
<td>Body mass index (Kg/m²)</td>
<td>Caffeine + concurrent training</td>
<td>2.21±29.20</td>
</tr>
<tr>
<td></td>
<td>Concurrent training + placebo</td>
<td>1.89±27.23</td>
</tr>
<tr>
<td>Fat percentage (%)</td>
<td>Caffeine + concurrent training</td>
<td>2.32±33.97</td>
</tr>
<tr>
<td></td>
<td>Concurrent training + placebo</td>
<td>1.50±32.89</td>
</tr>
</tbody>
</table>

The results of analysis showed that waist circumference of subjects in both groups of supplementation and placebo significantly reduced by about 9.9% and 4.9% respectively ($P<0.05$), but the difference between two groups was not significant ($P>0.05$). The body fat percentage in girls with overweight showed a significant reduction ($P<0.05$) in both supplementation and placebo groups about 5.7% and 3.3%, respectively. However, the difference in decreased body fat percentage between caffeine supplementation and placebo groups (about 2.4 percent) was not significant ($P>0.05$). Blood triglyceride levels of caffeine supplementation and placebo groups were non-significantly reduced about 4.4 and 3.4 percent. In addition, the drop in triglyceride level of caffeine supplementation group compared to the placebo group (about 0.1 percent) was not statistically significant ($P>0.05$). Although the total cholesterol level of participants in caffeine supplementation group significantly decreased about 8.4 percent; and the decrease in placebo group was about 7.5 percent and statistically not significant, however more drop in total cholesterol of the group that receiving caffeine supplements compared to the one receiving placebo

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386
(approximately 0.9%) was not statistically significant (P>0.05). HDL and LDL levels were decreased insignificantly in both groups, respectively at a rate of 0.5 and 8.31 percent for supplementation group and 3.28 and 1.14 percent for placebo group, and no significant difference was found between two groups (P<0.05).

**Discussion and Conclusion**

The findings of this study showed that after four weeks of concurrent training (aerobics-resistance), body fat percentage and waist circumference significantly reduced, which matches with the results of Sheykholeslami vatani et al. (2015) (Sheikholeslami-Vatani, Siahkouhian, Hakimi, & Ali-Mohammadi, 2015) and Ghahramanloo et al. (2015) (Ghahramanloo et al., 2009). Concerning the mechanism of fat percentage and waist circumference reduction and lean mass improvement of participants involved in concurrent training, it can be referred to the interplay between aerobic and resistance exercises of the training. Generally speaking, increase in lean body mass and fat cell lipolysis are respectively related to resistance training and aerobic exercise (Fyfe et al., 2014).

Therefore, regarding the results of this study, the concurrent training used in this research can help to lose weight and to reduce body fat mass and to increase the lean body mass. On the other hand, any decrease in total body fat, also reflects reduced visceral fat and interventions such as exercise will reduces visceral fat with a constant ratio. It's been shown that in response to the exercise, visceral fat decrease faster than total body fat and a weight loss of 10% causes up to 35% decrease in visceral fat. In general it can be concluded that any weight loss reduces visceral fat and thus leads to a reduced abdominal circumference, which is shown in the results of the present study as well (Farrell, Joyner, Caiozzo, & Medicine, 2012; Medeiros et al., 2015). However, the results of previous researches, including Ligibel et al (2009) is in conflict with the findings of the present study (Ligibel, 2009). An explanation for this paradox can be related to the intensity and duration of the exercise, age, sex and health state of participants and other things (Asad, 2013).

Also, in the present study, after four weeks of concurrent training (aerobics-resistance) along with caffeine supplementation (5 mg per kg of body weight) similar changes were observed as a significant decrease in body fat percentage and waist circumference and an insignificant increase in lean body mass. In this regard, few studies have examined the effect of concurrent training along with caffeine Supplementation on body composition indices. However, the role of methylxanthines including caffeine and its ergogenic effect during exercise is that caffeine works in the CNS and adipose tissue by connecting to the adenosine receptors and increasing the intracellular concentration of cyclic AMP (Graham, 2001). In fact, the researchers state that the inhibitory effect of the caffeine on phosphodiesterase excitation increases the fat oxidation, since the phosphodiesterase excitation cause the intracellular cyclic AMP to be reduced. This mechanism leads to a longer excitation of adrenergic receptors (especially Beta adrenergic receptors) and intracellular accumulation of AMP increases (Su et al., 2013).

Increasing the concentration of AMP in adipose tissue, increases the lipolysis. As a result, caffeine during exercise with more intensity or longer duration decrease the consumption of muscle glycogen and leads to increased needs for free fatty acids, and as a result, increases lipolysis. Also, stimulation of the sympathetic nervous system, for example as a response to exercise or caffeine consumption may suppress appetite and increase satiety. Therefore, weight loss and decreased body fat percentage in this study and similar studies could be due to the effect of caffeine on people's food intake (Haghighi, Ya'aghubi, & Hosseini Kakhak, 2013; Maughan, 1999). Therefore, this finding is consistent with Haghighi et al. (2013) and Nagao et al. (2005) (Nagao et al., 2007).

Thus, the lack of clarity in the results of this study related to the body composition, in the caffeine supplementation group compared to the placebo group, can be due to the lack of the measurement of the lipolysis enzymes activity and inadequate training course in this research compared to the other studies, inadequacy of the amount of consumed caffeine and the lack of responsibly of the participant's body to supplement or the probability of not taking the supplement by participants.

However, the findings of this study is not consistent with the results of Diepvens et al. (2005). Diepvens et al. (2005) investigated the effect of consuming the caffeine combinations with low-calorie diet on resting energy expenditure and substrate oxidation and body weight in overweight women for twelve weeks, and suggested that consuming the caffeine combinations with low-calorie diet has no significant effect on body weight and fat-free mass (Diepvens, Kovacs, Nijs, Vogels, & Westerterp-Plantenga, 2005).

Then, reviewing the results of biochemical indices of lipid profile in overweight girls revealed that four weeks of concurrent training (aerobics-resistance) caused insignificant reduction in triglycerides, total cholesterol, high-density lipoprotein and low-density lipoprotein. Often fat is the main fuel of skeletal muscle at rest and during the exercise with low to moderate intensity. In terms of absolute amounts, the fat contribution in
total produced energy, increases from low output power up to the range of 65 - almost 85% of maximal oxygen consumption. So, in exercise with low to moderate intensity, fat can produce large and significant amounts of energy (Farrell et al., 2012).

Above findings are consistent with the results of other researchers including lhym et al (2015) and Leo (1391). It should be noted that a large amount of fat is stored as triglycerides in adipose tissue in different areas of the body, and the ability of the adipose tissue in response to the dynamic exercise which is due to the activation of triglyceride hydrolysis and the release of free fatty acids into the blood to increase and maintenance of free fatty acid transport into the working muscle, is important. Recent studies revealed the important role of phosphorylation using hormone and activated protein kinase in the local control of Intracellular hormone-sensitive lipase (HSL), enzyme activity and interaction with regulatory proteins of Perry Lipin A to coordinate the control of fat storage tissue lipolysis. Lipolysis in resting adipose tissue is maintained at low level using the inhibitory effect of plasma catecholamines. But during the dynamic exercise that comes along increased activity of the sympathetic system and aggregation of epinephrine and norepinephrine in the blood, it has a powerful effect on the combined dominant inhibitory effect at rest condition. Increased norepinephrine and epinephrine during exercise bind them to beta-adrenergic receptors and activates G excitatory protein and. These changes increase the activity of adenylate cyclase, produce cAMP, activities PKA, and finally increase the phosphorylation of HSL, Perry Lipin and possibly triglyceride lipase, which these events can increase the triglyceride breakdown. So probably we did not see the significant changes in our results, because we did not measure blood catecholamines, and the enzymes mentioned above (Farrell et al., 2012).

Consistent with the findings of this study lhym et al (2015) studied 48 inactive men in three groups of endurance, strength and concurrent trainings; and reported that none of exercises has a significant effect on cholesterol, triglycerides and low-density lipoprotein levels. However, high-density lipoprotein had significantly increased, which is inconsistent with the results of the present study (Oluboyo, Nndonim, & Onyenekwe). In this context, it can be stated that HDL changes resulting from resistance, aerobic and concurrent exercises is influenced by the intensity of the exercise and seems that combined training has better effect on improving cardiovascular risk factors than resistance or endurance trainings. And the reasons of these changes can be associated to the activity of lipoprotein lipase and Listin cholesterol transferase that increase by exercises and these two enzymes decrease LDL, triglycerides, total cholesterol, and increase HDL. Also, the difference in HDL changes may be due to the differences in the intensity and type of exercise (high, medium and low) or their duration. Typically, after high intensity workouts HDL level have more increases compared to low intensity workouts In addition, different variations of HDL could be due to differences in weight, sex and type of sexual hormones (Asad, 2013).

Regarding the non-significant reduction of plasma lipoproteins in plasma, it should be referred to insulin deficiency. Reduced insulin of the plasma, may lead to increased concentration of cholesterol and phospholipids of plasma and increased fatty acids of plasma in lack of insulin cause hepatic conversion of some fatty acids into the cholesterol and phospholipids of plasma, which are two main product of fat metabolism. These two substances besides the produced Triglycerides in the liver enter into the blood in the lipoproteins form. So the plasma lipoproteins increase up to three times in the absence of insulin three (Hall, 2015). Therefore, small and insignificant decrease in lipoproteins may be due to reduced insulin in participants. The lack of insulin measurement is one of the limitations of this study. Also it can be referred to the few number of participants, the short duration of exercise and disregarding the diet by participants without the knowledge of the researcher (Haghhighi et al., 2013).

In addition, concerning the changes of lipoproteins of plasma, two factors of plasma volume and weight changes must be taken into account. In general, plasma lipids are expressed based on their concentration (mg in Deciliter of blood), any changes in plasma volume influence the plasma concentration independent of total fat changes. On the other hand, exercise increase plasma volume. With increase in the volume of plasma, HDL-C level may not change or even may decrease. In addition, plasma lipid levels depend on changes in body weight. So, when assessing the effect of exercise on plasma lipid, the independent effects of weight changes of plasma must be considered. So, another limitation of the present study was the lack of plasma volume measuring and the lack of weight changes of the participants (Wilmore, 1994).

However, the present findings have some conflicts with the results of other studies, including Gnahramanloo et al (2009). Gnahramanloo et al. (2009) studied untrained young men and after eight weeks of endurance and concurrent training reported significant increase in HDL, and significant decrease in LDL and fat mass. However resistance training did not cause a significant influence on these indices. While all three type of exercises significantly decreased total cholesterol and triglyceride. This contradiction could be due to sexual differences and duration of the training.

388
program. Since the changes of lipid profile in women is less than men, in response to exercise training (Ghahramanloo et al., 2009). Also, at the end of the four-week concurrent training (aerobics-resistance) along with caffeine supplementation (5 mg per kg of body weight) total cholesterol was significantly decreased. While decrease in triglyceride, high-density lipoprotein and low-density lipoprotein were not significant. Concerning this, Wang et al (2010) reported that different doses of caffeine in overweight people didn't cause significant changes in the HDL, LDL, triglycerides and total cholesterol levels, this ineffectiveness might be due to the low dose of caffeine (Wang et al., 2010). However, to explain the mechanism of caffeine's effect on lipid profile indices one can be say according to research results, any increase in plasma level of paraxanthine (a caffeine derivative) is strongly associated with an increase in free fatty acids. Also, caffeine as a nonselective inhibitor, inhibits the function of nucleotide phosphodiesterase cycle groups of enzymes and activates protein kinase a pathway and subsequently phosphorylates the hormone-sensitive lipase. Increased lipid conversion and oxidation due to interaction of Cori cycles and triglyceride cycle and acting as a heating factor can explain the role of caffeine associated with the metabolism of lipids. Researchers also suggested that decrease of mesenteric lymph flow and decrease of fatty acids absorption as limitations posed by decreasing effect of caffeine on triglycerides (Asl et al., 2014; Su et al., 2013). In addition, Liu and colleagues (2013) reported that consumption of caffeine compounds didn’t have a significant effect on the triglycerides and low-density lipoprotein levels in obese men and women. However, unlike the results of this study, they reported the five percent of increase in HDL (Liu, Smith, Fujioka, & Greenway, 2013). On the other hand, the results of this study is not consistent with Hackman et al (2006) that reported a significant improvement of cardiovascular risk factors such as cholesterol, triglycerides and HDL, caused by a dietary supplement containing caffeine in healthy postmenopausal women (Hackman et al., 2006). The difference between the results of two studies can be caused by the study samples. Because the female hormones which work as a protective factor for cardiovascular disease during premenopausal, are reduced after menopause. So it is likely that caffeine supplementation in postmenopausal women can increase the risk factors of cardiovascular disease including high levels of LDL, triglyceride and low levels of HDL (Wilmore, 1994).

Findings of this study consistent with the results of some previous studies, showed that after four weeks of concurrent training (aerobics-resistance) along with caffeine supplementation, the changes of body composition indices to some extent led to improved body composition and lipid profile parameters in overweight girls. However, regarding the training and supplementation period, more studies are needed to explain the exact result.

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Conflict of interest
The authors declare no conflict of interest.

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389
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