Does the Concurrent Training Affect on Plasma Homocysteine Level?

Otadi Kh*, Emamdoost S, Faramarzi M, and Otadi M

***Abstract*---** The increased level of homocysteine (Hcy) is correlated with the early coronary artery disease, heart attack and atherothrombosis even among individuals with normal levels of cholesterol and reducing the Hcy levels is correlated with the reduced incidence of heart attck. Most studies performed on impacts of sport activities on Homocysteine have mainly concentrated on aerobic exercises and some findings are conflicting. This study was extorted to determine the effects of a concurrent training on rest level of homocysteine of plasma in non-athlete subjects. For the purpose of this study , 30 non-athlete employees were randomly divided into case (those who underwent the exercises) and control groups man of 15 in each group. The exercises consisted of 8 weeks of exercise, three sessions a week and each session included 10-12 station resistance, strength exercises and aerobic running in the end. Blood samples were collected before and after exercising, at rest time and after night fasting. Following serum collection, plasma Homocysteine levels was measured by ELISA method. The results indicated that Implementations of 8 weeks of concurrent training didn't have influence on concentrations of plasma Hcy

***Keywords*:** Concurrent training, Homocysteine, Body composition, Non-athletes

I. Introduction

HOMOCYSTEINE is a non-protein α-amino acid. Abnormally high levels of homocysteine in the serum, above 15 µmol/L, are a medical condition called hyperhomocysteinemia. This has been claimed to be a significant risk factor for the development of a wide range of diseases, including thrombosis, neuropsychiatric illness, and fractures. It is also found to be associated with microalbuminuria which is a strong indicator of the risk of future cardiovascular disease and renal dysfunction. Hyperhomocysteinemia has been correlated with the occurrence of blood clots, heart attacks and strokes. A high level of homocysteine in the blood makes a person more prone to endothelial cell injury, which leads to inflammation in the blood vessels, which in turn may lead to atherogenesis, which can result in ischemic injury. Hyperhomocysteinemia is therefore a possible risk factor for coronary artery disease. Coronary artery disease occurs when an atherosclerotic plaque blocks blood flow to the coronary arteries, which supply the heart with oxygenated blood.

Khadijeh Otadi (PhD) (*corresponding author) is with Department of Physiotherapy, Tehran University of Medical Sciences, Tehran, Iran. (e-mail: k_otadi@razi.tums.ac.ir).

Saeid Emamdoost (MSc. in Sport Physiology), Endocrine & Metabolism Science Research Institute, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran.

Mohammad Faramarzi (Assitant Professor of Physical Education, Shahrekord University of Physical Education& Sport Sciences).

Mansooreh otadi is with the Department of Dental Biomaterial , School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran. (e-mail:sana.otadi@gmail.com)

Physical activity and training programs contribute to controlling cardiovascular risk factors and reducing the risk of atheroscelerosis development. However, the understanding and review of studies related to the effects of physcical activity and training programs on homocysteine levels are rarely discussed in the literature, despite being important knowledge for the diagnosis and control of atherosclerosis.

Given physical exercise induces changes in protein and amino acid metabolism. It is important to understand whether homocysteine levels are also affected by exercise and to determine its possible underlying mechanisms.

Most studies performed on impacts of sport activities on Homocysteine have mainly concentrated on aerobic exercises and some findings are conflicting.

In this study we assessed the effect of concurrent training on homocysteine level.

On the other hand, researchers reported a significant reduction in fasting Homocysteine levels in young women after 6- 12 months of performing aerobic exercises for four days a week and 30-45 minutes. This Homocysteine reduction took place without any changes in the fat mass [6].

Few studies have been conducted on the effect of resistance exercises (working with weights) on Homocysteine

Recently, long- term resistance exercises have become significant effect and positive changes in Hcy Therefore, considering limited studies carried out on the impact of concurrent training on Homocysteine and their potential effect on energy costs and body composition changes, particularly fat mass and fat percentage, studying the effect of this exercise on homocysteine changes can be considerable and taken into account as a new and effective intervention in changing hormonal risk factors of cardiovascular diseases.

Considering the mentioned points, this study aims at investigating the effect of a course of concurrent training on plasma homocysteine changes that is a new exercising approach and can be accompanied by physiologic effects of both strength and resistance exercises.

II. Material And Methods

Non-athlete male employees of Tehran university of Medical Sciences without organized sport activities , no smokers and without high blood pressure or diabetics were the cases under study. The sample, 30 cases, was taken from among the volunteers and then, they were randomly divided into the case

http://dx.doi.org/10.15242/IICBE.C0615091

(15 persons) and control (15 persons) groups who respectively took part in combined exercises and routine activities.

All cases participated in the study were fully aware of the objectives and method of the study and entered the study voluntarily; they were also assured that they could leave at any point of the study. In addition, all subjects completed and signed the informed consent of human volunteers participating in research studies of the University of Medical Sciences.

The anthropometric information including height, weight, BMI and WHR were measured using the relevant relationships. BMI was calculated by dividing weight (Kg) by square height (m) and WHR was determined through dividing waist round in the narrowest area (around the navel) by hip circumference. The maximum consumed oxygen was evaluated by a 12-minute running/walking test.

Basic information was gathered in the pretest and was similarly repeated in all posttests after the intervention (8 weeks of exercise).

Before and after exercising, at rest time and after night fasting, blood samples were taken from both groups. At rest homocysteine plasma levels were analysed through ELISA using Homocysteine Human Elisa Kit, a specialized kit, from Biosource Company. Following the 8-week program, blood samples were taken at rest time and after night fasting to re-assess their homocysteine levels amd examine probable changes.

The combined group had three sessions of concurrent training within one week and the control group was following their routine program.

The resistance combined exercising program consisted of 10-12 station strength exercises including major moscular groups. The intensity of the exercises within the first and the second four-week course was 70-75% of 1RM and 75-80% of 1RM, respectively. In the combined exercise group, a 10-minute run with 70-75% of MHR intensity in the first four-week round and a 13-minute run with 75-80% of MHR intensity in the second round were added to the rsistance exercising program.

The data were classified based on descriptive statistics and the preliminary statistical indices were determined. In order to specify the difference in each group, dependent and independent t-tests were used within each group and between the groups, respectively.

TABLE I
CONCURRENT TRAINING PROGRAM

Endurance – resistance training protocol

Training pattern over first month phase				
	program design	intensity	repetitions	Number of sets
1st station	Leg press	70-75% 1RM	10-12	1
2nd station	Bench press	70-75% 1RM	10-12	1
3rd	Leg curl	70-75% 1RM	10-12	1
4th	Barbell biceps	70-75% 1RM	10-12	1
5th	Leg extension	70-75% 1RM	10-12	1
6th	Triceps pull down	70-75% 1RM	10-12	1
7th	Seated leg curl	70-75% 1RM	10-12	1
8th	Cable raise lateral	70-75% 1RM	10-12	1
9th	Calf raise	70-75% 1RM	10-12	1
10th	Lateral raise	70-75% 1RM	10-12	1
11th	Sit-ups	70-75% 1RM	10-12	1
12th	Back extension	70-75% 1RM	10-12	1
endurance	10 min running	70-75% MHR		

Training pattern over second month phase				
	program design	intensity	repetitions	Number of sets
Resistance training	Same protocol	75-80% 1RM	6-8	2
endurance	13 min running	75-80% MHR		

III. RESULTS

Table II shows the descriptive characteristics of the testees in pre and post tests as well as the results of examining intra-group changes.

TABLE II
INTRA-GROUP CHANGES OF VARIABLES

Index	Groups	Pre-test	Post-test	P
Age (yrs.)	*concurrent training*	33.13±5.15	33.13±5.15	-----
	Control	32.13±5.15	32.13±5.15	-----
Height (cm)	*concurrent training*	174.77±7.11	174.77±7.11	-----
	Control	172.73±6.88	172.73±6.88	-----
Weight (kg)	*concurrent training*	90.23±15.90	15.03±87.43	0.01*
	Control	15.56±93.05	15.28±93.64	0.07
Homocysteine	*concurrent training*	6.52±4.30	5.85±3.28	0.20
	Control	9.31±6.84	11.33±6.36	0.46

P is versus control group. * indicates significant difference.

Table III shows the results of comparing the experimental and control groups in the post-test.

TABLE III
INTER-GROUP CHANGES OF VARIABLES

Index	Groups	Pre-test	Post-test	P
Weight (kg)	*concurrent training*	90.23±15.90	15.03±87.43	0.27
	Control	93.05±15.56	93.64±15.28	
	Control	37.99±5.13	39.48±5.68	
Homocysteine	*concurrent training*	11.05±6.07	11.17±5.59	0.37
	Control	12.41±7.73	12.01±7.69	

The present study indicated homocysteine levels of non-athletes did not change significantly after 8 weeks of exercise.

IV. DISCUSSION

Although adaptabilities and responses of significant physiologic variables associated with cardiovascular risks including Homocysteine to endurance and resistance exercises were studied in some researches, few studies have been conducted on the impact of compound exercises, a relatively new method, on new risk factors of cardiovascular diseases like Homocysteine. The findings of the study showed that compound exercise didn't have any significant effect on Homocysteine levels in male athletes. There is limited data on the effect of resistance exercises on homocysteine levels.

Konig in 2003 [2] revealed that the although intense exercise acutely increased the Hcy levels, chronic endurance exercise was not associated with higher Hcy concentrations. Moreover, athletes with the highest training volume, exhibiting also the highest plasma folate levels, showed a decrease in Hcy levels following the training period as well as a much lower increase of the Hcy concentration after acute intense exercise. The combined effect of training and higher plasma folate levels to reduce Hcy should be investigated in future studies.

Vincent in 2003 [3] examined the effect of 6 months of high- or low-intensity resistance exercise on serum homocysteine and lipoprotein (a) levels in adults aged 60-80 years. Forty-three men and women completed the study protocol. Subjects were randomly assigned to a control (n=10), low-intensity (LEX, n=18), or high-intensity (HEX, n=15) group. Subjects performed 6 months of resistance training at either 50% of their one-repetition maximum for 13 repetitions (LEX) or 80% of one-repetition maximum for eight repetitions (HEX) 3 times per week for 24 weeks. The load was increased by 5% when their rating of perceived exertion dropped below 18. One-repetition maximum; serum homocysteine; lipoprotein (a); total and high-density lipoprotein cholesterol; and dietary intake of vitamins B12, B6, and folic acid were measured pre- and poststudy. Upper and lower body strength significantly ($p<0.05$) increased for the LEX and HEX groups. Serum homocysteine decreased 5.30% and 5.34% for the LEX and HEX groups, respectively ($p<0.05$), but increased 6.1% for the control group. A significant increase in lipoprotein (a) levels was noted in the control and LEX groups from pre- to poststudy. No significant differences were noted either pre- or poststudy for total and high-density lipoprotein cholesterol or any dietary variables. These data indicate that significant reductions in serum levels of homocysteine in the elderly can be derived from resistance exercise training.

In one study by comparison of the influence of volume-oriented training and high-intensity interval training on serum homocysteine and its cofactors in young, healthy swimmers. Vitamin B6 and MMA did not change. For none of the measured parameters were there significant differences between HIT and VOL. Three weeks of strenuous swimming caused a prolonged Hcy increase, which was accompanied by changes in vitamin B12 and folate. The magnitude of these effects was not influenced by the training intensity [4].

Hayward data in 2003 demonstrate that exercise training improves endothelium-dependent vaso relaxation following HCY exposure and this may be due, at least in part, to elevated levels of eNOS (endothelial nitric oxide synthase) protein and an increase in eNOS activity. These results suggest the possible role exercise may play in attenuating the endothelial dysfunction associated with hyperhomocysteinemia [5]. This investigation examined the effect of 6 months of high- or low-intensity resistance exercise on serum homocysteine and lipoprotein (a) levels in adults aged 60-80 years. Forty-three men and women completed the study protocol. Subjects were randomly assigned to a control (n=10), low-intensity (LEX, n=18), or high-intensity (HEX, n=15) group. Subjects performed 6 months of resistance training at either 50% of their one-repetition maximum for 13 repetitions (LEX) or 80% of one-repetition maximum for eight repetitions (HEX) 3 times per week for 24 weeks. The load was increased by 5% when their rating of perceived exertion dropped below 18. One-repetition maximum; serum homocysteine; lipoprotein (a); total and high-density lipoprotein cholesterol; and dietary intake of vitamins B12, B6, and folic acid were measured pre- and poststudy. Upper and lower body strength significantly ($p<0.05$) increased for the LEX and HEX groups. Serum homocysteine decreased 5.30% and 5.34% for the LEX and HEX groups, respectively ($p<0.05$), but increased 6.1% for the control group. A significant increase in lipoprotein (a) levels was noted in the control and LEX groups from pre- to poststudy. No significant differences were noted either pre- or poststudy for total and high-density lipoprotein cholesterol or any dietary variables. These data indicate that significant reductions in serum levels of homocysteine in the elderly can be derived from resistance exercise training.

In one systematic review after 34 studies were identified, correlative and comparative studies of homocysteine levels revealed lower levels in patients engaged in greater quantities of daily physical activity. Regarding the acute effects of exercise, all studies reported increased homocysteine levels. Concerning intervention studies with training programs, aerobic training programs used different methods and analyses that complicate making any conclusion, though resistance training programs induced decreased homocysteine levels. In conclusion, this review suggests that greater daily physical activity is associated with lower homocysteine levels and that exercise programs could positively affect homocysteine control [6].

http://dx.doi.org/10.15242/IICBE.C0615091

Tsai 2015: High homocysteine levels are a risk factor for cognitive impairment in older adults[7]. In the present study, serum homocysteine levels were significantly reduced in the exercise group after 12 months of resistance exercise, echoing the findings of a previous study in which serum homocysteine decreased after 6 months of high- or low- intensity resistance exercise [3]. Although the potential mechanisms by which resistance training might prevent cognitive decline in the elderly involve homocysteine[8], the present study did not show an association between changes in homocysteine levels and changes in neuropsychological and neuroelectric measures. A possible explanation for this is that the cognitive task adopted in this study related to executive functions, with new research suggesting that high homocysteine levels in elderly adults only decrease performance in tests of immediate and delayed memory, not executive functions [8]. Although a few studies have demonstrated prolonged potential latencies in P3 amplitude associated with elevated homocysteine levels [9], [10], as in all experimental studies with a cross-sectional design, it is difficult to infer causal relationships between serum homocysteine levels and neurocognitive performance in healthy elderly males.

Therefore, in attention to above studies it seems that should be done further research about of homocysteine and exercise training with long term exercise. Maybe the one of the factors in dereasing of homocysteine level of plasma is a intensity and duration of exercise.

V. Conclusion

Overall, considering the few studies conducted on the effect of resistance and endurance exercises on changes in homocysteine basic levels, findings of the present study suggest the concurrent training did not have significantly affect on homocysteine basic level. Further studies with longer time periods would be required for studying more stable and specific effects of the exercises.

Acknowledgment

We appreciate all who helped us to exert the present study.

References

[3] Vincent KR, Braith RW, Bottiglieri T, Vincent HK, Lowenthal DT. ... exercise on serum homocysteine and lipoprotein (a) levels in adults aged 60-80 years. Preventive Cardiology 10/2003; 6(4):197-203

[2] König D, Bissé E, Deibert P, Müller HM, Wieland H, Berg A. Influence of training volume and acute physical exercise on the homocysteine levels in endurance-trained men: interactions with plasma folate and vitamin B12. Ann Nutr Metab.2003;47(3-4):114-8. http://dx.doi.org/10.1159/000070032

[4] Boreham C, Kennedy R, Murphy M, Tully M, Wallace W, Young I. Training effects of short bouts of stair climbing on cardiorespiratory fitness, blood lipids, and homocysteine in sedentary young women. Br J Sports Med. 2005 Sep; 39(9): 590–593. http://dx.doi.org/10.1136/bjsm.2002.001131

[5] Kevin R ViHayward R, Ruangthai R, Karnilaw P, Chicco A, Strange R, McCarty H, Westerlind KC. Attenuation of homocysteine-induced endothelial dysfunction by exercise training.Pathophysiology. 2003 Sep;9(4):207-214 http://dx.doi.org/10.1016/S0928-4680(03)00023-3

[6] Silva A. D.S. , Mota M. P.G. D .Effects of physical activity and training programs on plasma homocysteine levels: a systematic review. Amino Acids . 04/2014; 46(8).

[7] Ford,A.H.,Flicker,L.,Singh,U.,Hirani,V.,andAlmeida,O.P.(2013). Homocysteine,depression and cognitive function in older adults. J. Affect. Disord. 151, 646–651. http://dx.doi.org/10.1016/j.jad.2013.07.012

[8] Liu-Ambrose,T.,Nagamatsu,L.S.,Graf,P.,Beattie,B.L.,Ashe,M.C.,and Handy,T.C.(2010). Resistan cetraining and executive functions: a12-month randomized controlled trial. Arch.Intern. Med. 2009,170, 170–178. http://dx.doi.org/10.1001/archinternmed.2009.494

[9]. Díaz-Leines,S., Peñaloza-López, Y.R.,Serrano-Miranda, T.A.,Flores-Ávalos, B.,Vidal-Ixta,M.T., and Jiménez- Herrera,B. (2013). Evaluation of psychoacoustic tests and P300 event-related potentials in elderly patients with hyperhomocysteinemia.Acta Otorrinolaringol.Esp.64, 265–272 http://dx.doi.org/10.1016/j.otoeng.2013.08.008

[10]Evers,S.,Koch,H.G.,Grotemeyer,K.H.,Lange,B.,Deufel,T.,andRingelstein, E. B.(1997).Features, symptoms and neurophysiological findings in stroke associated with hyperhomocysteinemia. Arch.Neurol. 54, 1276–1282. http://dx.doi.org/10.1001/archneur.1997.00550220074017