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The Effect of Aerobic Athletic Program for Rehabilitation of Hypertensive Patients and its Effect on Physical Efficacy and Some Biological Variables

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Abstract: This research aims to study the effect of aerobic exercise program for rehabilitation of hypertensive Patients and its effect on physical efficacy and some biological variables. Two equal groups were used: one is the experimental group and the other is the control group (each of 10 persons).The population of the study aged 55-65 years. The results showed improvement in the experimental group parameters in comparison with the control group which received only medical treatment for hypertension and hyperlipidaemia. The improvement percentages were 4.85% in aspartate transferring enzyme (AST), 3.93% in alanin transferring enzyme (ALT), 2.80%in TC, 6.97% in HDL, 4.19% in LDL, 7.03% in TG, 2.70%in H.R, 4%40 in SBP and 8.16% in DBP.

Key words: Athletic · Aerobic · Rehabilitation · Physical Efficacy · Some Biological Variables

INTRODUCTION

With the recent scientific progress and wide use of machines, the human being became machine dependant which led to decreasing the physical activity. Thus the human being became the target of the attack of many diseases as obesity, hypertension and atherosclerosis. If the treatment is neglected it may lead to death.

Blood pressure is the pressure inside the main arteries of the body which results from cardiac propulsion of blood and the peripheral resistance to its passage. Hypertensive patients are more exposed to diabetes, defective blood lipid level, obesity and all predispose to early atherosclerosis and arterial lumen narrowing with adverse effects on heart, brain and kidney function. Hypertension may be asign of defective body metabolism and coagulation systems.Incease in body weight, fat accumulation in the abdominal wall and around the viscera, increase blood sugar and triglycerides levels, hypercoagulability and cardiac muscle hypertrophy [1].

Hyperlipidaemia is the main factor of cardiac diseases as a result of the decrease in physical and sport activities which participate in burning of excess body fats specially which lead to arteriosclerosis as cholesterol and triglycerides [2, 4].

The use of therapeutic exercises and sports for treatment and rehabilitation of todays diseases is a new concept to restore the pre-disease state, decrease the economic cost which results from the use of antihypertensive drugs and also decrease the drug therapy side effects. The aerobic exercises decease hyperlipidaemia specially triglycerides and total cholesterol (high and low density lipoproteins)causing general improvement in health[5].

Walking help in lowering triglyceride level by taking triglycerides carrying enzyme. In Baylor faculty of medicine study (Hosten), a study group of 12 persons asked to walk once for two hours another group did not walk. After 15 hours both groups had high fatty meal, the result was 31% Triglycerides lower concentration in those who walk in comparison with the other group [6].

Life style modification that includes regular physical activity is often recommended to patients with hypertension as one of the first line treatments for lowering blood pressure, as well as improving overall risk for cardiovascular events. The minimum amount of exercise that is recommended in hypertensive patients compromise mix of moderate to vigorous aerobic(endurance)activity(up to 5 times/week) in addition to resistance (strength) training (2 or more

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non consecutive days/week) [7]. Supervised or home based exercise programs allow a nonpharmacological reduction of hypertension and reduce risk factors with possible beneficial effects on cardiovascular morbidity [8].

Six months supervised aerobic and strength training showed that the exercisers had 7.1mmHg reduction in SBP,increase in VO(2) peak, increase fitness and decrease fatness. These effects suggest that the exercise training improve multiple factors that have an independent influence on SBP [9]. Also interval exercise training for 8weeks for a duration of 45-60 min/day, reveal significant effect on erectile function in hypertensive patients with erectile dysfunction [10].

Dynamic exercise training practiced in 3 days aweek,each session of 60 minutes during 6 months at moderate intensity (50% of heart rate reserve) in hypertensive post menopausal women result in significant reduction in blood pressure accompanied by marked increase in NOx levels which has beneficial effect with improvement of vascular relaxing and reduction of blood pressure [11]. 29 mild hypertensives were randomly assigned to 4 weeks of resistance exercise and aerobic training, there was significant decrease in SBP, DBP and improved autonomic nervous system [12].

In most patients, hypertension is asymptomatic disease so it is called the silent killer. The danger of this disease is due to its effects on heart, kidneys, brain and arteries. Hypertension is the main risk factor of stroke and its sequales. Also there is a tide relationship between hypertension, cardiac muscle hypertrophy and arteriosclerosis especially of the coronary arteries which may cause myocardial damage and death [1]. The genetic, environmental and living conditions play an important role in occurrence of hypertension and hyperlipidaemia in the majority of patients. The genetic factors prepare the body for the appearance of the disease in the presence of environmental factors which include: obesity, excess intake of salt, alcohol, deficiency of some mineral in diet (as Ca, K and Mg), emotional stress, anxiety, sedentary life, environmental pollution and medications which cause elevation of blood pressure. Awarness of these risk factors may prevent hypertension and hyperlipidaemia and reduce the use of medications which cost millions of pounds. Antihypertensive medications are the second line of treatment while physical activity, life style and dietary modifications are the first line of defense of cardiac diseases [6].

The idea of this study is the use of aerobic athletic program for the hypertensive patients with hyperlipidaemia which has beneficial effect in lowering both blood pressure and blood lipid levels, in turn lowering the economic cost of the use of antihypertensive medications for both patients and society and also increasing the physical and health efficacy of these patients.

MATERIALS AND METHODS

Purpose of the study To investigate the efficacy of aerobic athletic program for rehabilitation of hypertensive patients through:

- The effect of purposed program on physical efficacy through its effect on aspartate transferring enzyme (AST) and alanine transferring enzyme (ALT)
- The effect of exercise program on some biological variables.
- Blood lipids(total cholesterol(T.C), high density lipoprotein(HDL), low density lipoproteins (LDL), triglycerides(T.G)
- Heart rate(H.R), systolic and diastolic blood pressures(SBP and DBP)

Hypotheses

- There will be significant statistical differences in the post-exercise physical efficacy and biologic variables of the experimental group.
- There will be significant statistical differences in the post-exercise physical efficacy and biologic variables of the control group.
- There will be significant statistical differences in the post-exercise physical efficacy and biologic variables of both the experimental and the control group.

Subjects: 24 patients with mild to moderate hypertension (SBP 140-180 mmHg and DBP90-110 mmHg) and hyperlipidaemia (age 55-65 years) were divided into two groups equally. These patients did not use medical treatment for neither hypertension nor hyperlipidaemia. The first group included 10 patients who practice the athletic program. The second group also included 10 patients who received medical treatment for hypertension and hyperlipidaemia only as a control group. And 4 patients were discarded because of irregularity in practice.

Table 1: The main variables of the study (N= 20)

NO	Variables	Unit	Mean	Median	STD.	SK	KS
1-	Age	Year	61.20	61.50	3.20	1.21	0.32
2-	Height	Cm	17.390	175	4.01	0.91	0.60
3-	Weight	Kg	102.65	102.50	3.58	1.17	0.17
4-	AST	IU/L	46.20	46	1.57	0.10	0.10
5-	ALT	IU/L	33.75	34	1.11	0.52	0.05
6-	TC	mg/100cm 3	263.40	262.50	3.13	0.38	0.71
7-	HDL	mg/100cm3	34.05	34	1.05	0.21	0.19
8-	LDL	mg/100cm3	172.25	172	2.12	0.75	0.22
9-	TG	mg/100cm3	189.45	189	2.50	0.10	0.36
10-	HR	Beat/minute	110.20	110	3.54	0.52	0.08
11-	SBP	mmHg	158.50	160	6.70	0.54	0.17
12-	DBP	mmHg	106.90	106.50	4.65	0.71	0.05

Table 2: The difference between the mean measurements of the study parameters before testing for the experimental and the control groups. (N1=N2=10)

		Study group		Control group			
NO	Variables	Mean	STD.	Mean	STD.	Mean differences	T
1-	Age	60.70	3.49	61.70	2.98	1.0	0.068
2-	Height	173.80	4.15	174	4.08	0.20	0.11
3-	Weight	103.10	3.90	102.20	3.39	0.90	0.55
4-	AST	46.40	1.95	46	1.15	0.40	0.56
5-	ALT	33.60	1.07	33.90	1.19	0.30	0.60
6-	TC	263.70	3.12	263.10	3.28	0.60	0.42
7-	HDL	34.10	0.99	34	1.15	0.10	0.21
8-	LDL	172.10	2.18	172.40	2.17	0.30	0.31
9-	TG	189.70	2.98	189.20	2.04	0.50	0.43
10-	HR	110.40	3.86	110	3.39	0.4.	0.24
11-	SBP	158	6.32	159	7.37	1.0	0.32
12-	DBP	107.30	4.16	106.50	5.29	0.80	0.37

Value of (T) table at significant level 0.5=1.73

Table 1 indicates the mean, median, standard deviation (SD), kurtosis, skewness of the study parameters indicating the homogeneity of the data as skewness value (±3) which points to disorders free data.

Table 2 shows that there were no statistical significant in the pre-test study between the experimental and the control groups as the value of (T) table more than the significant level calculated at ($P < 0.05$) indicating equivalent parameters of the two groups.

Methods:

- The sample of the study was hypertensive patients with associated hyper lipidaemia aged 55-65 years.
- The pre-test measurements were done on Monday 6-7-2010 including serum collection, measuring HR, blood pressure after fasting for 12-14 hours and stopping the medications that reduce hypertension and hyperlipidaemia for 24 hours.
- The sample of the study were classified into two equivalent groups each contained 10 persons. The experimental group practiced the exercise program while the control group continued the medical treatment.
- The exercise program was applied under medical supervision during the period from Tuesday 7-7-2010 to Wednesday 1-9-2010.
- After exercise, measurements were done in Saturday 2-9-2010 for both the experimental and the control groups with the same conditions as the pre-test measurements.

Methods of Measuring the Study Variables:

- Blood samples were collected in the laboratory during rest in the morning for both the pre-exercise after exercise study after fasting for 12-14 hours

- HR measured peripherally by palpating the radial artery at the radial aspect of the forearm for 15 seconds, then calculation by number of pulses/15 second ×4 [13].
- Arterial BL.P measured by sphygmomanometer and stethoscope via a specialist.

Statistical Analysis: Mean, median, standard deviation (STD), kurtosis (KS), skewness (SK), paired samples T test (T) and improvement percentage (I.P)

RESULTS AND DISCUSSION

Table 3 shows significant difference between the pre-test and post-test variables measurements of the experimental group. The improvement occurred in the post test variables as the value of the calculated (T) is more than the table (T) at ($P < 0.05$). Fig.1 shows the highest improvement was in HDL (29.33%) while the least improvement was in HR (7.97%).

Table 4 shows significant differences between the pre-test and post-test variables measurements of the control group the improvement occurs in the post test parameters as the value of the calculated (T) more than the table (T) at ($P< 0.05$). Fig. 1 shows that the highest improvement was in HDL (22.35%) while the least improvement was in HR (5.27%).

Table 5 shows significant differences between the post test variables measurements of the first (experimental) and the second (control) groups. The improvement occurs in the post test variables of the experimental group.

Discussion of the First Statistical Hypothesis: Table 3 shows significant statistical differences in the physical efficacy of the experimental group in the form of a decreased amino acid transferring enzymes, a 17.3% decrease in AST and 11.31% decrease in ALT (Fig.1) and this due to the effect of aerobic exercise training program.

Table 3: The differences between the means of pre and post test variables measurements of the experimental group in the physical efficacy and some biologic variables in the study. (N= 10)

		Before study		After study				
NO	Variables	Mean	STD.	Mean	STD.	Mean Dif.	T	IP.%
1-	AST	46.40	1.95	38.50	2.17	7.90	11.44	17.03
2-	ALT	33.60	1.07	29.80	1.3	3.80	7.75	11.31
3-	TC	263.70	3.12	207.80	4.07	55.90	39.64	21.20
4-	HDL	34.10	0.99	44.10	1.44	10	27.38	29.33
5-	LDL	172.10	2.18	155.4	3.86	16.70	11.09	9.70
6-	TG	189.70	2.98	148.70	4.27	41	49.39	21.61
7-	HR	110.4	3.86	101.60	2.76	8.80	8.82	7.97
8-	SBP	158	6.32	141.60	2.50	16.40	10.67	10.38
9-	DBP	107.30	4.16	92	3.12	15.30	7.91	14.26

Value of (T) table at significant level 0.05=1.83

Table 4: The differences between the mean pre and post test variables measurements of the control group in the physical efficacy and some biologic variants in the study. (N= 10)

		Before study		After study				
NO	Variables	Mean	STD.	Mean	STD.	Mean Dif.	T	IP%.
1-	AST	46	1.15	40.40	1.57	5.60	9.05	12.17
2-	ALT	33.90	1.19	31.40	1.17	2.50	6.22	7.37
3-	TC	263.10	3.28	214.70	7.67	48.40	17.08	18.40
4-	HDL	34	1.15	41.60	1.77	7.60	14.59	22.35
5-	LDL	172.40	2.17	162.90	3.14	9.50	13.82	5.51
6-	TG	189.20	2.04	161.60	5.42	27.60	19.49	14.59
7-	HR	110	3.39	104.20	2.52	5.80	11.12	5.27
8-	SBP	159	7.37	149.50	6.75	9.50	27.81	5.97
9-	DBP	106.50	5.29	100	7.07	6.50	2.32	6.10

Value of (T) table at significant level 0.05=1.83

Table 5: The differences between the mean post test variables measurements of both the experimental and the control groups. (N1=N2=10)

		Study group		Control group				
NO	Variables	Mean	STD.	Mean	STD.	Mean Dif.	T	IP%.
1-	AST	38.50	2.17	40.40	1.57	1.90	2.23	4.85
2-	ALT	29.80	1.03	31.40	1.17	1.60	3.23	3.93
3-	TC	207.80	4.07	214.70	7.67	6.90	2.51	2.80
4-	HDL	44.10	1.44	41.60	1.77	2.50	3.45	6.97
5-	LDL	155.4	3.86	162.90	3.14	7.50	4.76	4.19
6-	TG	148.70	4.27	161.60	5.42	12.90	5.91	7.03
7-	HR	101.60	2.76	104.20	2.52	2.60	2.09	2.70
8-	SBP	141.60	2.50	149.50	6.75	7.90	3.46	4.40
9-	DBP	92	3.12	100	7.07	8	3.27	8.16

Value of (T) table at significant level 0.05=1.73

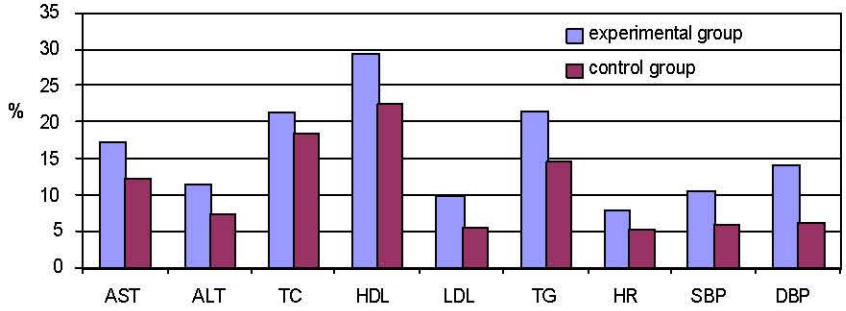

Fig. 1: The improvement percentage in the pre and post study variables measurements for both the experimental and the control groups

The amino acids transferring enzymes inversely related to the physical efficacy, the enzymes levels decreased with increased physical efficacy. The decrease in the amino acids transferring enzymes associated with improvement in the physical efficacy reflecting the physiological accommodation resulting from regular sport practice [14].

Table 3 shows significant statistical differences of the post test blood lipid measurements. Fig.1 shows a decrease in TC concentration (IP21.20%),increase HDL concentration(IP29.33%),a decrease in LDL concentration(IP9.70%),a decrease in TG concentration(IP21.20).These effects are due to the regular aerobic exercise training program of the study group. Regular physical activity improved the percentage of TC, HDL, LDL which decrease the risk of cardiovascular diseases [15].

It was previously observed that regular exercise program for 8 weeks administered to a group of patients with hyperlipidaemia causing a 10% decrease in TC concentration, a 24% decrease in TG concentration [16, 17]. There is a direct proportion between LDL concentrations and coronary heart diseases while HDL concentration inversely related to coronary heart diseases, The higher HDL concentration; the lower the risk of coronary artery diseases [18].

Table 3 shows significant statistical differences for the experimental group in the variables of HR, SBP and DBP. Fig.1 shows a 7.97% improvement in HR pointing to increase cardiac muscle efficacy. Increased physical efficacy due to regular sport practice improve HR [19]. The study also shows decrease in SBP(IP 10.38%) and DBP(IP 14.26%) which indicates improved cardiac muscle efficacy and a decrease in the peripheral resistance as a result of decreased TC concentration, increased HDL concentration and decreased LDL concentration. It was previously observed that sport training restores the sensitivity of the Barroreflex and muscle sympathetic nerve activity in the patients who never use antihypertensive medications and this leads to decreased HR and blood pressure [20]. The regular arm aerobic exercises decrease both SBP and DBP and improve small arteries compliance [21].

Blood pressure is an important index of circulation state and cardiac and blood vessels vitality. Blood pressure is the expression of the pressure on the blood vessels which depend on the blood vessels resistance and the cardiac beat [22]. From the above, there significant difference in post test physical efficacy and biologic variables of the experimental group.

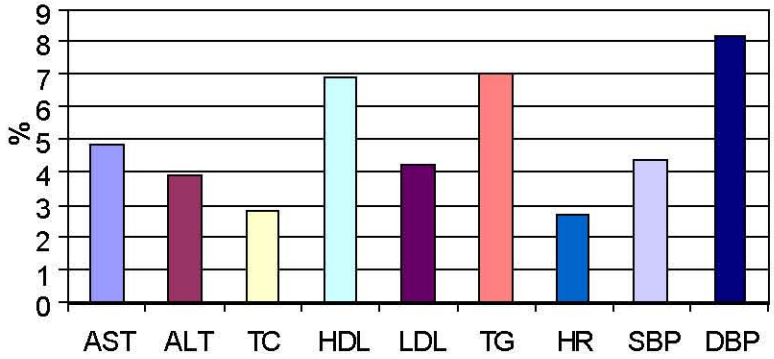

Fig. 2: The improvement percentage in the control group's variables after testing in relation to the pre-test variables

Discussion of the Second Statistical Hypothesis: Table 4 shows statistical significant differences (P< 0.05) in the physical efficacy of the control group in the form of decreased amino acid transferring enzymes. Fig.1 shows12.17% decrease in AST and 7.37%decrease in ALT.

The authors attribute this result to the use of antihypertensive and blood lowering lipid drugs as the statin activates the liver to remove LDL via increasing the hepatic LDL receptors and lowering of blood pressure and lipid levels may lead to increasing amino acid transferring enzymes and physical efficacy [6].

Table 4 shows statistical significant differences (P< 0.05) in blood lipid level in the post measurements of the control group. Fig.1 shows a decrease in TC(IP 21.20%), an increase in HDL concentration (IP29.33%), a decrease LDL,TG concentrations(IP 9.70%,14,59% respectively) the authors attribute that to the use of anti-lipidaemic drugs as statin inhibit the action of HMG-CO A Reductase which play an important role in alternating the concentration of TC,LDL and an increase in HDL in the serum resulting in decreasing the risk of cardio vascular diseases [6].

Table 4 shows statistical significant differences (P< 0.05) in the post measurements of the control group: decrease HR,SBP,DBP(IP 5.27%,5.97%, 6.10% respectively) the authors may attribute that to the use of antihypertensive and anti-lipidaemic drugs which lead to decrease TC, LDL,TG and increase HDL which result in improvement of the circulation condition as a result of decrease arterial resistance to the blood flow which decrease blood pressure and increase cardiac muscle and physical efficacy of the control group.

Discussion of the Third Statistical Hypothesis: Table 5 shows statistical significant differences (P<0.05) in the post measurements of both groups in the favors of the experimental group in all variables of the study at (p< 0.05) the value of calculated (T) was more than the table (T). Fig. 2 shows a decrease amino acid transferring enzymes, a decrease in AST concentration (IP4.85%)and a decrease in ALT concentration(IP3.93%)in favor of the control group which indicates the aerobic exercise program increased the circulatory and the physical efficacy more than the blood lipid lowering drugs as it is associated with decreased amino acid transferring enzymes concentration due to regularity in sport practice, increased physical efficacy associated with decreased amino acids transferring enzymes.

Table 5 shows statistical significant differences between the post measurements of TC of both groups in favors of the experimental group. Fig.2 shows a decrease in TC concentration(IP 2. 80%), an increase in HDL concentration(IP 6.97%), a decrease in LDL concentration (IP4.19%),a decrease in TG concentration(IP 7.03%)of the experimental group indicating the effect of the rehabilitation program as a non medical means in lowering blood lipid level more than that of the drugs.

Table 5 shows statistical significant differences between the post measurements of HR, SBP and DBP in favor of the experimental group. Fig.2 shows a decrease in HR, SBP and DBP(IP 2.70%, 4.40%,8.16% respectively) of the experimental group which shows improvement more than the control group which use the medical treatment and this considered as an index of physical condition improvement and increased cardiac muscle efficacy. It was observed that improvement of physical efficacy improve HR [19]. It was observed that low intensity exercise decease SBP, DBP, HR and increase the baroreflex sensitivity and in consequence the circulatory functions [23]. Also running on treadmill and resistance exercises

lower SBP, DBP, HR and lactic acid concentration in blood [24]. The effect of continuous low intensity exercise program is decrease in SBP, DBP, uric acid serum concentration and improved VO2 max. This study was effective non pharmacological mean to decrease CVS diseases via lowering serum uric acid [25].

From the above we find significant differences in the physical efficacy and the biological parameters of the study in the after test measurements for both the experimental and the control groups in the favor of the experimental group

CONCLUSION

- The proposed rehabilitation exercise program improved the physical efficacy via decreasing the AST and ALT transferring enzymes (17.03%, 11.31% respectively) in the experimental group.
- The proposed rehabilitation exercise program improved the blood lipid level in the experimental group via 21.20% decreasing in TC, 29.33% increase in HDL, 9.70%decrease in LDL and 21.20%decrease in T.G concentrations.
- The proposed rehabilitation exercise program decreased HR, SBP, DBP (IP 7.97%, 10.38%, 14.26% respectively) which points to increasing cardiac muscle efficacy and decreasing the peripheral resistance of blood vessels.
- Drugs which lower blood pressure and blood lipids levels improved the physical efficacy as it led to a 12.17%decrease in AST, a 7.37%decrease in ALT enzymes.
- Drugs which lower blood pressure and blood lipids levels improved blood lipids level as it led to a 21.20%decrease in TC, a 29.33%increase in HDL, a9.70% decrease in LDL and a 14.59% decrease in TG concentrations.
- Drugs which lower blood pressure and blood lipids levels also decreased HR, SBP and DBP (5.27%, 5.97% and 6.10% respectively).
- The proposed rehabilitation exercise program shows Drugs which lower blood pressure and blood lipids levels as the exercise program led to decrease AST and ALT concentrations (IP 4.85%, 3.93%respectively), improvement of blood lipids concentrations as it led to decreasing TC increasing HDL, decreasing LDL and TG (IP2.80%, 6.97%, 4.19%, 7.03% respectively) and also improved the cardiac muscle efficacy via decrease HR, SBP, DBP (IP 2.70%, 4.40%, 8.16% respectively).

Recommendation

The Researchers Recommend:

- Proposed rehabilitation exercise program as a non pharmacological means for lowering blood pressure and lipid levels instead of medications.
- Similar studies need to be undertaken.
- There is a regular medical need for checkup and measuring blood pressure and blood lipids level.
- There is a need for regular participation in sport activities longtime.
- Further studies for rehabilitation of different diseases.

REFERENCES

1. Ibrahim, M.M., 2000. Types, causes and risks of hypertension.1st Edition. Al-Ahram center for translation and publishing, Cairo, pp: 1-11.
2. Lee, R., D. Nieman and J. Lee, 1991. The effect of acute moderate exercise on serum lipids and lipoproteins in mildly obese women. Intl. J. Sports Medicine, 12: 537-542.
3. Davis, P.G., W.P. Bartoli and J.L. Durstin, 1992. Effects of acute exercise intensity of plasma lipids and apolipoprotiens in trained runners. J. Appl. Physiol., 72: 914-919.
4. Angelopouls, T., J. Robertson, F.L. Gross, K.P. Metz and L.E. Laporte, 1993. Effect of repeated exercise bouts on high density lipo-protein, cholesterol and its sub-fractions HDL2-C and HDL3-C. Intl. J. Sport Med., 14: 196-201.
5. Hargreaves, M., 1995. Exercise metabolism. Human kinetics publishers, Champaign, 15: 112.
6. Kastely, W., 2003. Cholesterol therapy. Arabian science center, Beirut., pp: 226-227.
7. Sharman, J.E. and M. Stowasser, 2009. Australine Association for exercise and sports science position statement on exercise and hypertension, School of human movement studies, Univeristy of Queensland, Australia. J. Sci. Med. Sport, 12: 252-257.
8. Manfredini, F., A.M. Malagoni, S. Mandini, B. Boari, M. Felisatti, P. Zamboni and R. Manfredini, 2009. Sport therapy for hypertension: why, how and how much?. Angiol., 60: 207-16.
9. Barron, B.B., N.Y. Wang, A.C. Bacher and K.J. Stewart, 2009. Decreased exercise blood pressure in older adults after exercise training: contribution of increased fitness and decreased fatness. British J. Sport Med., 43: 52-56.

10. Lamina, S., C.G. Okoyeand and T.T. Dagogo, 2009. Therapeutic effect of an interval exercise training program in the management of erectile dysfunction in hypertensive patients. J. Clin. Hypertension, 11: 125-129.
11. Zaros, P.R., C.E. Pires, M.J. Bacci, C. Moraes and A. Zanesco, 2009. Effect of 6-moths physical exercise on nitrate/nitrite levels in hypertensive postmenopausal women. BMC women health, 9: 17.
12. Collier, S.R., J.A. Kanaley, R.J. Carhart, V. Frechette, M.M. Tobin, N. Bennett, A.V. Lucckenbaugh and B. Fernhall, 2009. Cardiac autonomic function and baroreflex changes following 4 weeks of resistance versus aerobic training in individuals with pre-hypertension. Acta Physiologica, 195: 339-48.
13. Abd El-Fatah, A.A. and M.S. Hassanin, 1997. Sport physiology and morphology and methods of measurements for correction. Dar Al-Fikr Al-Arabi, Cairo, pp: 113.
14. Malmore, M., J. Thompsoa and M. Russo, 1993. Diet and exercise strategies of the world. Class body builders. Int. J. Sport Nutr., 3: 76.
15. Rowell, L.B., 1996. Human circulation regulation during physical stress. Oxford University press, New York, pp: 419.
16. Dufaux, B., G. Assmann and W. Hollman, 1994. Biochemische aspekte derlipoprotein veranderungen bei sportlern. Munch Med. Wschr., 160: 239.
17. Chen, G., K. Koyama and R. Unger, 1996. Disappearance of fat in normal rats. Proc. Nat. Acad. Sci., 25: 1479.
18. Khaliel, M.A., 1994. Study the effect of an aerobic program for weight control on lung efficacy and serum lipid concentration. Journal of hypothesis and applications, Faculty of sport science for boyes, Alex., Egypt, 18: 39.
19. Taha, S.K., 1992. Sports and biology principles. El-Maadi publisher, Cairo, pp: 42.
20. Laterza, M.C., L.D. Matos, I.C. Trombetta, A.M. Braga, F. Roveda, M.J. Alves, E.M. Krieger, C.E. Negrao and M.U. Rondon, 2007. Exercise training restores baroreflex sensitivity in never treated hypertensive patients. Hypertension, 49: 1298-306.
21. Westhoff, T.H., S. Schmidt, V. Gross, M. Joppke, W. Zidek, M. Van der Giet and F. Dimeo, 2008. The cardiovascular effects of upper limb aerobic exercise in hypertensive patients. J. Hypertension, 26: 1336-1342.
22. Sharkey, B.J., 1990. Physiology offitness. 3rdEd. Humman Kinetics Publishers, Champaign, Illinois, pp: 194.
23. Ciolac, E.G., G.V. Guimaraes, D. Avila, L.A. Bortolotto, E.L. Doria and E.A. Bocchi, 2009. Acute effects of continuous and interval aerobic exercise on 24-h ambulatory blood pressure in long term treated hypertensive patients. Intl. J. Cardiol., 133: 381-387.
24. Mota, M.R., E. Pardono, L.C. Lima, G. Arsa, M. Bottaro, C.S. Cample and H.G. Simoes, 2009. Effects of treadmill running and resistance exercises on lowering blood pressure during the daily work o f hypertensive subjects. J. Strength and Conditioning Res., 23: 2331-2338.
25. Lamina, S. and C.G. Okove, 2010. Effect of low intensity continuous training program on serum uric acid in the non pharmacological management of hypertension: randomized controlled trail. Nigeria J. Med., 19: 77-86.