effect of regular exercise on blood pressure, serum glucose and lipid profile in females attending fitness centers

Submitted in : 22/5/2010 Accepted in: 22/9/2010

Suzan Sami Ali *

ABSTRACT

Background and objectives: Previous reports have shown that moderate-intensity regular exercise reduces blood pressure, also has beneficial effects on other biochemical parameters. The aim of this study was to determine the effects of regular exercise on blood pressure and lipid profile in overweight or obese women.

Methods: Thirty five apparently healthy women participated in this study. Their age ranged from 22-46 years, most of them were overweight and obese. The exercise group met a Treadmill training program 2 km in half hour in J&K and Raeky fitness centers in Erbil city. The training group exercised at least three times per week. Blood pressure, heart rate, serum glucose and lipid profiles were monitored throughout 4 weeks of regular exercise.

Results: Regular exercise produced significant reductions in both blood pressure and heart rate (Systolic BP decreased from 123.57±3.76 to 113.93±3.52 mmHg, Diastolic BP decreased from 81.07±9.8 to 73.57±2.59mmHg). Highly significant reductions in total cholesterol and low density lipoprotein were observed, whereas no significant changes were detected in serum glucose, triglycerides and High density lipoprotein levels.

Conclusion: These data suggest that 4 weeks of regular exercise training in normal persons can result in significant reduction in blood pressure accompanied by favorable changes in lipid profile.

Key words: Exercise, blood pressure, lipid profile, overweight and obese women

INTRODUCTION:

Many guidelines for prevention and treatment of hypertension recommended lifestyle modification in the form of regular dynamic (aerobic) exercise as well as a reduction in dietary sodium intake and weight control[1]. Regular aerobic exercise involves large muscle groups engaged in rhythmic repeated movements like jogging, brisk walking, swimming and bicycling. For many years, physical inactivity has been recognized as a risk factor for coronary heart diseases (CHD) and most recommendations suggest regular physical activity as a part of the strategy in preventing /reducing CHD [2]. It has been reported that moderate-intensity activity max (the rate of oxygen usage under maximal aerobic metabolism), aerobic exercise is associated with a significant reduction of blood pressure (BP) in hypertensive and normotensive participants and in overweight, as well as normal-weight participants [3]. Interestingly, increasing exercise intensity to above 70% VO_2 max did not have any additional impact on blood pressure reduction[4] .Thus, guidelines from the department of Health center in south Australia suggest that each individual should participate in a minimum of 30 min of moderate intensity activity at lest 5 days a week . A frequency of three exercise sessions per week has been considered to be the minimal frequency for BP reduction [5]. Observational studies

* Assistant lecturer, dept. of physiology, College of Medicine, HMU.

active people have BP levels around 5 mmHg lower than inactive individuals. Even if the absolute benefit from the lower BP may be small, but in a health perspective, it has the potential to substantially decrease mortality and morbidity within the community if a sufficiently large proportion of the population increase their level of physical activity [6]. The beneficial effect of regular exercise in hypertension is not limited to reduction of BP only. It has also been shown to reduce left ventricular hypertrophy[7], improve exercise capacity and quality of life [8]. When combined with dietary alteration, regular exercise causes reduction of oxidative stress, increases nitric oxide (NO) availability and improves the overall metabolic profile[9]. Endothelium-dependent relaxation of resistance vessels by agonists such as acetylcholine is impaired in hypercholesterolemia[10,11]. It has been hypothesized that an influence of cholesterol on vascular tone may affect BP[11]. Reviewing recent lipid- lowering trials, Good et al .1995, have provided evidence for an association between plasma concentration of cholesterol and resting BP. This association, however, is relatively weak and cholesterol-lowering therapy results in only a modest reduction in BP [12]. Hypercholesterolemia may influence vascular reactivity to a greater degree than basal tone, such an effect might influence BP during exercise more strongly than BP at rest [10] . Growing recognition that obesity often plays a causal or complicating role in the pathogenesis of hypertension and type 2 diabetes mellitus has led to widespread interest in mechanisms that might link obesity with altered renal function [13]. Hypertension, dyslipidemia and excess body weight are among the most potent accepted risk factors for cardiovascular disease (CVD). Weight loss has beneficial effects on BP, lipid and glucose control. In addition, weight loss in a range of 5-10% of initial weight can offer significant improvement of these variables [14,15]. One of the possible pathways that link (BMI) and serum lipid and lipoprotein levels. Elevation of total cholesterol (TC), triglycerides (TGs) and low density lipoprotein (LDL-C) are documented as risk factors for atherogenesis . The latter is the primary carrier of cholesterol [16]. It has been reported that a 1% reduction in a person serum TC level yields a 2- 3% reduction in the risk of CHD [17]. The risk of atherosclerosis and CHD increases by 20-30% for every 1mg/dl decrease in the blood level of high density lipoprotein (HDL-C)[18]. Recently published large prospective epidemiological studies have reported physical inactivity as predictor of not only cardiovascular but also total mortality in middle-aged men and women [19].This association is strong and independent of other major risk factors, and illustrates the enormous preventative potential of regular exercise, especially given the high prevalence of a sedentary lifestyle in most communities. It also implies that physical activity has a protective effect on non cardiovascular mortality too, although all the beneficial mechanisms are not totally understood [4]. The aim of this study was to determine the influence of regular exercise for 4 weeks on BP, and to evaluate its effects on lipid profile and blood sugar in overweight and obese women.

MATERIALS AND METHODS:

-Subjects:

This study was conducted over a period of 5 months. From March –July 2009 in J&K and Raeky fitness centers in Erbil city. Thirty five apparently healthy volunteer women participated in the study, most of them were overweight and obese and only 6 had normal BMI .Their age ranged from 22-46 years. The exercise group met a Treadmill training program of at least 3 sessions a week. Each session consisted of 2Km training in half hour. This program was applied for 4 weeks for each participant.

-Samples:

forearm vein of fasting participants who were previously advised by the researcher to fast overnight.. The blood samples were allowed to clot and serum was separated after centrifugation at 3000 rpm for 10 min.

-Measurements:

1. Measurements of fasting serum variables, include: glucose (F.S.G), triglyceride (S.TG), total cholesterol (S.TC) and high density lipoprotein(S. HDL) were done by enzymatic methods using kits (BIOLABO SA, 02160, Maizy, France) which are provided by WHO. Serum LDL-C was calculated by using the Friedewald equation as following:

LDL-C (mg/dl) =TC (mg/dl)-(HDL-C(mg/dl) +TG/5mg/dl) [20].

2. Both systolic and diastolic blood pressure (SBP& DBP) were measured before exercise and after 10 min from termination of exercise. The mean of these BP records were taken as measurement before and after exercise. Simultaneously the heart rate (HR) was recorded.

4-Statistical analysis:

All data are expressed as mean ± standard error of the mean (M±SEM) and statistical analysis was carried out using statistically available software (SPSS Version 11.5). P<0.05 was considered as statistically significant.

RESULT:

The results presented in table (1) show the mean ±S.E of BP (SBP /DBP), and HR before exercise and after 10min from termination of exercise at the beginning of experiment at day (0) or (1).

Measurements of BP in women performing treadmill exercise showed a statistically highly significant reduction in both SBP and DBP (P<0.001). The HR remained significantly high after 10 min from the termination of exercise.

Tables (2&3) Show measurements of BP and HR before and after exercise during 4 training weeks . SBP, DBP and HR significantly decreased with the course of exercise. The changes in BP are more clearly

seen in figs.1and 2.

Table (4) shows the effects of 4 weeks of regular exercise on BMI, waist circumference, serum glucose and lipid profile.

The results revealed statistically highly significant reductions in BMI, waist circumference, TC and LDL levels after 4 weeks of exercise. Whereas no significant changes were observed in serum glucose, TG and HDL levels.

Table 1: A comparison of BP, HR before exercise and after 10 min. from termination of exercise. (n=35)

parameters	Before exercise	After exercise	Statistical evaluation t. test for paired samples
SBP mmHg	112.56± 2.37	108.06± 1.88	P<0.001
DBP mmHg	72.62 ± 1.58	69.59 ± 1.35	P<0.001
HR beat/min	81.94 ± 1.17	92.21 ± 1.66	P<0.001

Table 2: Changes of Blood Pressure and Heart rate before and during 4 weeks of continuous training. (n=14)

parameters	1st week	2nd week	3rd week	4th week	Statistical evaluation t. test for paired samples 1st wk vs 4th wk
SBP mmHg	123.57± 3.76	120.36± 3.29	115.36± 3.76	113.93± 3.52	P≤0.002
DBP mmHg	81.07± 9.8	٧٩.٢٩± ١.٥٦	75.71± 1.73	73.57± 2.59	P<0.013
HR beat/min	85.79 ± 2.37	82.5± 2.3	82.71± 2.66	80.93 ± 1.55	P<0.01

Table 3: Changes of BP and HR during 4 weeks after exercise. (n=14)

parameters	1st week	2nd week	3rd week	4th week	Statistical evaluation t. test for paired samples 1st wk vs 4th wk
SBP mmHg	117.86± 3.73	114.29± 2.67	112.5 ± 3.47	108.21± 3.3	P<0.004
DBP mmHg	77.14 ± 2.44	75.36± 1.23	72.86± 1.79	69.29± 2.5	P<0.004
HR beat/min	97.36± 3.05	93.5 ±2.94	92.14 ± 3.54	90.43± 2.97	P<0.01

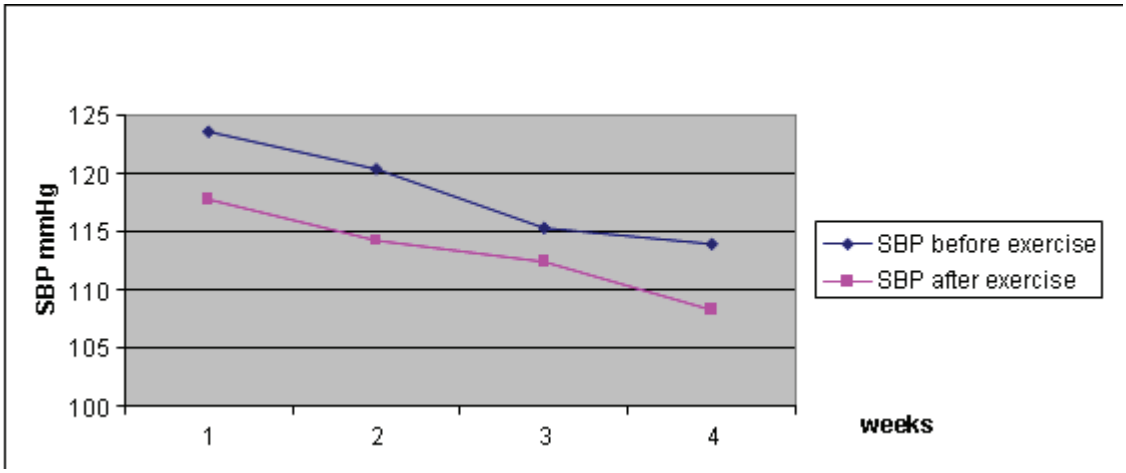

Figure1: Changes in SBP during 4 weeks of continuous exercise

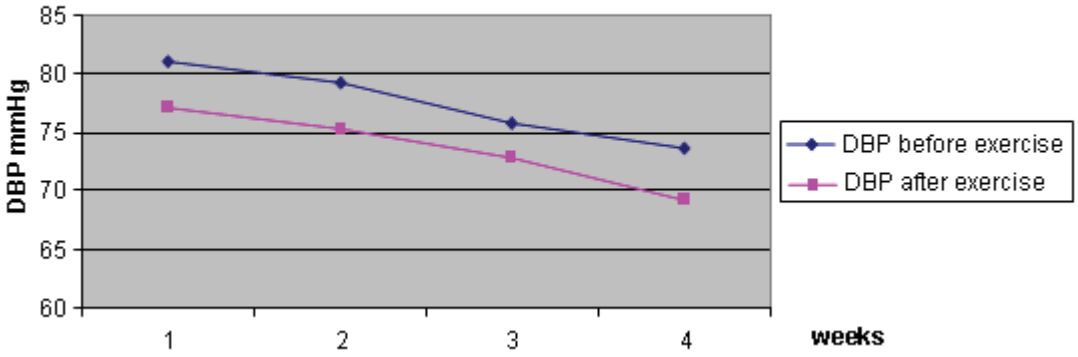

Figure 2: Changes in DBP during 4 weeks of continuous exercise

Table 4: Measurements of BMI, Waist circumference, serum glucose and lipid profile before and after 4 weeks of exercise.(n=35)

parameters	Before exercise	After exercise	Statistical evaluation t. test for paired samples
BMI kg/m^2	29.85±0.89	28.51±0.84	P<0.01
Waist circumference cm	99.1± 2.45	93.07± 2.23	P< 0.001
Glucose mg/dl	87.68± 4.14	87.87 ±3.3	N.S.
TG mg/dl	146.78 ±14.65	125.33±8.08	N.S.
TC mg/dl	205.92± 8.62	172.38 ±6.55	P <0.001
HDL mg/dl	54.99 ±2.38	57.14± 2.06	N.S.
LDL mg/dl	121.3 ± 9.09	91.12 ± 6.96	P < 0.01

DISCUSSION:

Most studies on blood pressure during exercise have focused on SBP[21] .It has been reported that measurements of BP immediately after exercise show an increase of 20-40mmHg in SBP, whereas DBP does not change or slightly decreases[22,23]. DBP measurements during exercise, however, are rarely reported, perhaps because of concern about the accuracy of such measurements[24]. The results of the present study showed small and highly significant decreases in both SBP and DBP after 4 weeks of exercise. been shown to be quite beneficial to reduce BP in hypertension as well as normal subjects [3,5]. It is interesting to note that most of the lowering of systolic and diastolic BP in those with hypertension occurs within a few weeks of consistent aerobic training. The exact mechanism how aerobic exercise helps to lower high blood pressure is unclear. However it is theorized that biochemical, neural and hormonal changes in the blood vessel walls cause an acute and long-term blood vessel relaxation[25].Vasodilation of resistance vessels in muscle during exercise is influenced by several

endothelium –independent mediators, including NO, prostaglandins, adenosine, and other metabolically linked vasodilators, such as potassium and hydrogen ions [26,27].During muscular exercise there is increased sympathetic discharge, so that both myocardial contractility and HR are increased. The increase in HR is particularly prominent in normal individuals, and there is only a modest increase in stroke volume [26.] There is consolidated evidence that physical activity exerts several beneficial effects on health, and can bring the serum lipid to an acceptable range, which is one of the metabolic adaptations contributing to the reduced risk of CHD[28]. It is recommended that brisk walking lowers BP and plasma glucose, and helps to reduce body weight in middle –aged obese individuals[29]. The results of the present study are in agreement with these findings, except serum glucose which was not influenced by exercise. It has been suggested that the major factor leading to an improved blood lipid profile, following regime, is the weight loss and decrease in body fat often seen with exercise training[30]. Weight loss is usually advocated as a first-line treatment for hypertension and hypercholesterolemia. In addition, the identification of weight – loss diets is likely to maximize the effects on blood pressure and blood lipids, both are of considerable importance. Significant positive correlation was fond between BMI and daily physical activity[31]. In the present study, parallel significant reductions were found in BMI and serum TC, TG,LDL levels after exercise indicating positive correlation between these parameters. These results are in agreement with the findings obtained by other investigators[32,33].The decreased TC and LDL-C after exercise may be due to the ability of these activities to alter their receptor production and secretion by the liver or decrease LDL receptor mediated LDL removal[34]. The data obtained indicate that the mean serum TG level after exercise was lower but not statistically significant (P> 0.05).This probably had in the values of TG of the small sample of participants. Furthermore, it has been reported that the primary reason for the elevation in HDL-C is an increase in lipoprotein lipase (LPL) activity in response to exercise. LPL accelerates the breakdown of TG[19].There was only a small increase in HDL level in the present study , hence the decrease in TG was not significant. These findings indicate that aerobic exercise may be an important adjunct for the lowering of BP and in the treatment of hypertension. The evidence shows that short-term intensive programs motivate subjects to change lifestyle risk factors. These lead not only to greater reduction of BP merely, but improvement in their overall metabolic profile also.

AKNOLEDJMENT:

I am indebted to both J&K and Raeky fitness centers in Erbil for their help in allowing access to women who attended their centers. Thanks are due to Dr. Ismail M. Maulood lecturer of physiology in the college of Science/University of Salahaddin for his valuable advice in statistical evaluations.

REFERENCES:

1. Williams B, Vaziri ND, Barnard RJ, Williams B, Poulter NR, Brown MJ et al . Guidelines for management of hypertension. Report of the fourth working party of the British Hypertension Society, 2004-BHS IV. J Hum Hypertens 2004; 18 (3):139-185.
2. Thompson PD, Buchner D, Pina IL, Balady G J, Williams MA, Marcus BH, et al. Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease. A statement from the Council on Clinical Cardiology (Subcommittee on Exercise, Rehabilitation, and Prevention)and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity).Circulation 2003; 107: 3109-3116.
3. Whelton SP, Chin A, Xin X and He J. Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trails. Ann Intern Med 2002; 136(7): 493-503.
4. Choudhury A, and Lip GYH. Exercise and hypertension. Journal of Human Hypertension 2005; 19: 585-587.

5. Halbert JA, Silagy CA and Finucane P. The effectiveness of exercise training in lowering pressure: a meta-analysis of randomized controlled trails of 4 weeks or longer. J Hum Hypertens 1997; 11: 641-649.
6. Fagard RH. Physical fitness and blood pressure. J Hypertens 1993; 11 (suppl 5): S47- S52.
7. Hinderliter A , Sherwood A, Gullette EC, Babyak M, Waugh R, Georgiades A, et al. Reduction of left ventricular hypertrophy after exercise and weight loss in overweight patients with mild hypertension. Arch Intern Med 2002; 162 (12):1333-9.
8. Tsai JC, Yang HY, Wang WH, Hsieh MH, Chen PT, Kao CC, et al. The beneficial effect of regular endurance exercise training on blood pressure and quality of life in patients with hypertension. Clin Exp Hypertens 2004; 26(3): 255-265.
9. Roberts CK, Vaziri ND and Barnard RJ. Effect of diet and exercise intervention on blood pressure, insulin, oxidative stress and nitric oxide availability.Circulation 2002; 106(20):2530-2.
10. Casino PR, Kilcoyne CM, Quyyumi AA, Hoeg JM and Panza JA. The role of nitric oxide in endothelium- dependent vasodilatation of hypercholesterolemic patients. Circulation 1993; 88:2541-7.
11. Good GK and Heagerty AM, In vitro responses of human peripheral small arteries in hypercholesterolemia after effects of therapy. Circulation 1995; 91:2898-2903.
12. Good GK, Miller JP and Heagerty AM. Hyperlipidaemia, hypertension and coronary heart disease. Lancet 1995; 345:362-364.
13. Hall JE. Renal and Cardiovascular mechanism of hypertension in obesity. Hypertension 1994; 23:381-394.
14. Walden TA, Anderson DA and foster GD. Tow-year changes in 10% reduction in initial weight: some finding and some questions. Obes. Res.1999; 7:170-178[medline].
15. Mertens IL and Van Gall LF. Overweight, obesity and blood pressure: the effects of modest weight loss. Obes. Res. 2000; 8: 270-278. (medline).
16. Kushnick MR. Lipid and lipoprotein metabolism in response to treadmill walking at tow level of caloric expenditure. A comparison of Black and white American men. M.Sc. thesis 2003.The Florida state university.
17. NCEP, National Cholesterol Education Program. The exercise &cholesterol controversy. JAMA 1993; 269(23):3015-23.
18. Durstine JL and Haskell WL. Effects of exercise training on plasma lipids and lipoproteins. Exercise and Sports Science Reviews 1994; 22: 477-522.
19. Aziz J, Siddiqui NA, Siddiqui IA, and Omair A. Relation of body mass index with lipid profile and blood pressure in young healthy students at Ziauddin medical university. J Ayub Med Coll
20. Barengo NC, Hu G, Lakka TA, Pekkarinen H, Nissinen A and Tuomilehto J. Low physical activity as a predictor for total and cardiovascular disease mortality in middle-aged men and women in Finland. Eur Heart J 2004; 25(24): 2204-11.
21. Fisch FA. Manual of laboratory and diagnostic test. 17th ed. 2004. Lippincolt Williams and wilkins. USA.
22. Manolio TA, Burke GL, Savage PJ, Sidney S, Gardin JM and Oberman A. Exercise blood pressure response and 5-year risk of elevated blood pressure in a cohort of young adults. The CARDIA study. Am J Hypertens 1994; 7: 234-241.
23. william F and Ganong MD. Review of Medical physiology. 26th ed. 2005; USA.
24. Guyton AC and Hall JE. Text book of medical physiology .11th ed. 2006; India.
25.Sally E, Brett BN, James M, Ritter FR, Philip J, and Chowienczyk FR. Diastolic blood pressure changes during exercise positively correlate with serum cholesterol and insulin resistance. Circulation 2000; 101: 611.
26.Kally GA, and Kelly KS. Progressive resistance exercise and resting blood pressure. A meta-analysis of randomized controlled trails. Hypertension 2000; 35: 838-843.
27. Wilson JR and Kapoor SC. Contribution of prostaglandins to exercise- induced vasodilation. Am J physiol 1993; 265: H171-H175.
28. Gilligan DM, panaza JA, Kilcoyne CM, Walclawiw MA, Casino PR and Quyyumi AA. Contribution of endothelium- derived nitric oxide to exercise –induced vasodilation. Circulation 1994; 90:2853-8.
29. Lippi G, Schena F, Salvagno GL, Montagnana M, Ballestrieri F, et al. Comparison of the lipid profile and lipoprotein (a) between sedentary and highly trained subject. Clin Chem Lab Med 2006; 44(3):322-326.
30. Kendra P and Bharti V. Effect of daily exercise on blood pressure plasma glucose and obesity measurements in 55-64 years old obese Indian men. American Journal of Human 2006; 18(5): 718-721.
31. Sharma AM, Mascitelli I, Pezztta F, Sletz CA. Effect of exercise on plasma lipoprotein. NEJM 2003; 448(15): 1494-6.
32. Edward S, Saikrupa D, Alice H, Gerard D, Alberto C, Ernst J, et al. An oat-containing hypo caloric diet reduces systolic blood pressure and improves lipid in men and women. Journal of Nutrition 2001; 131:1465-1470.
33. El-Yassin HD, Hasso NMA and Al-Rubayi HA. Lipid profile and lipid peroxidation pattern pre and post exercise in coronary artery disease. Turk J Med Sci 2005; 35:223-8.

34.Nemet D, Barkan S, Epstein Y, Fridland O, Kowen G, et al. Short- and long term beneficial effects of a combined dietary behavioral. Physical activity intervention for the treatment of childhood obesity. Pediatrics 2005; 115(4): e 443-e 449.