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Physiology

Comparison of Effects of Short Term (12 Weeks) Low, Moderate and High Intensity Exercises on Lipids and Lipoproteins Levels in Young Hyperlipidemic Adults

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ABSTRACT

Purpose of Study: To study and compare the effects of light, moderate and vigorous intensity exercise on serum total cholesterol (TC), triglycerides (TGs), low density lipoprotein cholesterol (LDL-c) and high density lipoprotein cholesterol (HDL-c) levels in hyperlipidemic adults. To evaluate the level of minimum physical activity required to keep the lipid profile under the desirable limits in hyperlipidemic adults in local population.

Objective: The effects of increased physical activity is related to reduce risk of cardiovascular disease, possibly due to improvement in the lipoprotein profile.

Study Design: Case control study.

Place and Duration of Study: This study was conducted in the Department of Physiology, BMSI, JPMC, Karachi from January 2012 to April 2012.

Materials and Methods: Total of 120 volunteers moderately active, young hyperlipidemic adults, aged 30 to 50 years, thirty for each A (control), B, C and D for low, moderate and high intensity exercise respectively were assigned to participate for 12 weeks exercise program without restricted caloric diet at pre–identified track of specific time. Lipids profile and age, sex, BMI and lab investigations like serum TC, TG, LDL, HDL, of each participant were recorded at baseline and similarly on day 30, 60 and day 90.

Results: There was a beneficial effect of exercise by lowering the level of lipid and lipoproteins variables, seen most clearly in moderate and high intensity of exercise with increasing the level of HDL but no significant effects were observed with the low intensity exercise.

Conclusion: These results indicate that the low intensity exercise has no beneficial effects in lowering the lipid and lipoproteins levels in hyperlipidemic adults but moderate and high intensity exercise has lipid and lipoproteins lowering effects with increasing the level of HDL significantly in hyperlipidemic young adults.

Key Words: Hyperlipidemia, Cholesterol, Triglycerides, LDL, HDL. Low, moderate and high intensity exercise.

INTRODUCTION

Lipids are heterogenous group of organic substances found in animal tissue and plants[1].

Lipids have the common property of being, relatively insoluble in water and soluble in non-polar solvent such as ether and chloroform[2].

An adult ingests about 81 grams of lipid per day, of which more than 90% is triacylglycerol. The remainder is made up of cholesterol, cholesterol esters, phospholipids and free fatty acids[3].

Functions of lipids:

1. Source of energy. Promote growth e.g. triacylglycerol.
2. Fat soluble vitamins have regulatory and co-enzyme functions[4].

Hyperlipidemia: Hyperlipidemia refers to elevated levels of lipids and cholesterol in the blood. Although elevated low density lipoprotein cholesterol (LDL) is thought to be the best indicator of atherosclerosis risk[5].It is believed that reductions in the serum LDL cholesterol level produced by dietary therapy will have similar benefits, however, the diet recommended for reducing LDL cholesterol levels may reduce HDL cholesterol levels to a similar degree[6].

Effect of exercise on plasma lipoprotein level: Regular physical activity is essential for maintaining physical and cardiovascular fitness, such as intermittent walking for 30 to 45 minutes, is recommended. Subsequent increases in physical activity to 30 to 60 minutes on most days, if not all days of the week need to be individualized[7].

Formula for calculating maximum heart rate: Estimation of maximum heart rate (HRmax) has been largely based on the formula: HRmax = 220-age in years[8]. For measuring their heart rate the participants were provided a wrist heart rate monitor with wireless chest band (Model Anova AS-H28).

Exercise program protocol: Exercise program was given to all participants at a pre-identified jogging track, at specific time and their exercise program was observed by the researcher. The total duration of

exercise was 45 to 60 minutes. Five to ten minutes warm up period; normal routine walk at low intensity. Started by walking jogging or running at an easy pace and gradually increasing the exercise intensity to reach desired heart rate zone, 20 to 30 of low intensity. Cool down with 5 to 10 minutes of lower intensity. End exercise with gentle stretching of muscles[9].

MATERIALS AND METHODS

The study was conducted in the Department of Physiology, BMSI, JPMC, between January 2012 to April 2012.

120 Adult male and female, aged between30 to 50 years diagnosed hyperlipidemic adults were divided into four (A-control, non exercise, B-light C-moderate and D-light intensity exercise) groups. 30 participants in each group. The intensity of activity exercise was measured with wrist heart rate monitor to calculate target heart rate zone. All participants had their lipid profile measured on base line, day 30, day 60, and day 90 by enzymatic reaction method. All the participants were volunteers and selected from general population of Karachi. A written informed consent was taken before enrolment, the entire four groups were oriented on whole experimentation and its importance. The three exercise groups followed the respective exercise protocols, where as the control group remained without physical activity for the entire period. The researcher took all the necessary precautions to see that all the subjects comply with the experimentation environment. All participants were selected according to the following criteria:

Inclusion Criteria: Young adults of both sexes with age group 30 to 50 years. Be able to qualify cardio-respiratory fitness test (Rockport 1 mile walk test), 70th percentile for age and sex.

Exclusion Criteria:

- Any medical condition that can contraindicate moderate to vigorous intensity exercise i.e. ischemic heart disease, arrhythmias, valvular heart disease, cardiomyopathy and physical disability.
- Chronic illnesses like Chronic renal failure (CRF), diabetes mellitus, malignancy, psychiatric illness.
- Pregnancy / Lactation.
- Any drugs affecting serum lipid levels i.e. antihyperlipidemic drugs, estrogen.
- Individuals having habitual of smoking, alcohol consumption.
- Individuals currently on an energy-restricting diet or exercise program.

Statistical Analysis: Data feeding and analysis was done on SPSS (Statistical Packages of Social Sciences) version 16.0. The results was given in the text mean and Standard error of mean (SEM) for quantitative variables i.e. age, height, weight, BMI, blood pressure and lipid profile. Statistical comparison between groups A, B, C and D was performed by Analysis of Variance (ANOVA) with tukey test. In all statistical analysis only p-value <0.01 will be considered significant.

RESULTS

Table 1 shows that Mean±SEM of age, height, weight, BMI, Blood pressure and lipid profile. In this table there were no significant difference in age, height, weight and BMI, Blood pressure and lipid profile in between group A, B,C, D ($p>0.05$) accept cholesterol.

Table 2 shows Mean±SEM of lipid profile on day 0, 30, 60 and 90 in group A, B, C and D. On base line total cholesterol were significantly less in group B (227.8±3.08) as compared to group A (244.8±3.71) $p<0.05$ and significantly high in group D (241.9±5.51) as compared to group B (227.8±3.08) $p<0.05$.

Table No.1: Baseline Characteristics Of Participants

	Group A (n=30) Controls/Non exercising	Group B (n=30) Low intensity exercise	Group C (n=30) Moderate intensity exercise	Group D (n=30) Vigorous intensity exercise	
	Mean ± SEM	Mean ± SEM	Mean ± SEM	Mean ± SEM	P-value
Age in years	42.1 ± 0.78	42.0 ± 1.02	41.2 ± 0.99	41.2 ± 1.14	0.843
Height in meter	1.66 ± 0.02	1.70 ± 0.02	1.67 ± 0.01	1.71 ± 0.02	0.107
Weight in kg	74.7 ± 1.85	75.4 ± 1.95	76.3 ± 1.54	75.1 ± 1.61	0.925
BMI	27.0 ± 0.50	26.5 ± 0.95	28.9 ± 0.63	25.6 ± 0.38	0.127
B.P. (systolic)	130.2 ± 2.22	130.5 ± 2.25	133.2 ± 2.29	129.8 ± 1.93	0.690
B.P. (diastolic)	83.3 ± 1.50	85.2 ± 1.19	85.0 ± 1.04	85.0 ± 1.17	0.692
Total Cholesterol	244.8 ± 3.71	227.8 ± 3.08 *	236.7 ± 4.65	241.9 ± 5.51 ◊	0.054
Triglycerides	212.7 ± 13.76	197.5 ± 10.11	211.0 ± 8.04	214.6 ± 8.62	0.641
LDL	192.1 ± 8.84	183.4 ± 3.25	185.2 ± 5.64	190.5 ± 8.41	0.780
HDL	35.8 ± 0.51	34.5 ± 0.75	36.2 ± 0.61	35.9 ± 0.77	0.316

Statistical significant as compared to * group A (controls) , ◊ group B (Low intensity exercise),

Table No.2: Comparison Of Lipid Profile Day 0, Day 30, Day 60 And Day 90 In Group A, B, C And D

Variables	Days	Group A (n=30) Controls/Non exercising Mean ± SEM	Group B (n=30) Low intensity exercise Mean ± SEM	Group C (n=30) Moderate intensity exercise Mean ± SEM	Group D (n=30) Vigorous intensity exercise Mean ± SEM	P-value
Total Cholesterol (mg/dl)	0	244.8 ± 3.71	227.8 ± 3.08*	236.7 ± 4.65	241.9 ± 5.51 ◊	0.054
	30	242.4 ± 3.28	227.2 ± 3.14	230.1 ± 4.88	206.2 ± 5.18 * ◊ ⅄	0.001
	60	241.8 ± 3.08	224.3 ± 3.09 *	222.8 ± 4.67 *	182.3 ± 5.39 * ◊ ⅄	0.001
	90	244.0 ± 3.67	223.7 ± 2.90 *	221.1 ± 4.38 *	170.4 ± 5.74 * ◊ ⅄	0.001
Triglyceride (mg/dl)	0	212.7 ± 13.76	197.5 ± 10.11	211.0 ± 8.04	214.6 ± 8.62	0.641
	30	212.8 ± 13.41	191.6 ± 10.23	191.2 ± 7.10	192.3 ± 8.26	0.351
	60	209.9 ± 13.06	187.1 ± 9.97	180.7 ± 7.15	171.3 ± 7.37 *	0.039
	90	210.9 ± 13.39	185.5 ± 9.63	171.7 ± 7.19 *	158.1 ± 7.30*	0.002
LDL (mg/dl)	0	192.1 ± 8.84	183.4 ± 3.25	185.2 ± 5.64	190.5 ± 8.41	0.780
	30	192.7 ± 9.05	181.0 ± 3.33	174.3 ± 5.15	171.0 ± 8.00	0.118
	60	192.6 ± 9.08	178.9 ± 3.28	164.8 ± 5.01 *	153.7 ± 8.08 * ◊	0.001
	90	193.5 ± 9.02	176.6 ± 3.38	150.8 ± 5.40 *	136.5 ± 7.94 * ◊	0.001
HDL (mg/dl)	0	35.8 ± 0.51	34.5 ± 0.75	36.2 ± 0.61	35.9 ± 0.77	0.316
	30	35.5 ± 0.50	34.5 ± 0.77	38.8 ± 0.67 * ◊	40.9 ± 0.56 * ◊	0.001
	60	35.6 ± 0.51	34.9 ± 0.76	39.4 ± 0.65 * ◊	42.8 ± 0.88 * ◊	0.001
	90	35.9 ± 0.55	35.6 ± 0.73	40.2 ± 0.66 * ◊	41.9 ± 0.93 * ◊	0.001

Statistical significant ($p<0.05$) as compared to
* group A (controls), ◊ group B (Low intensity exercise), ⅄ group C (Moderate intensity exercise)

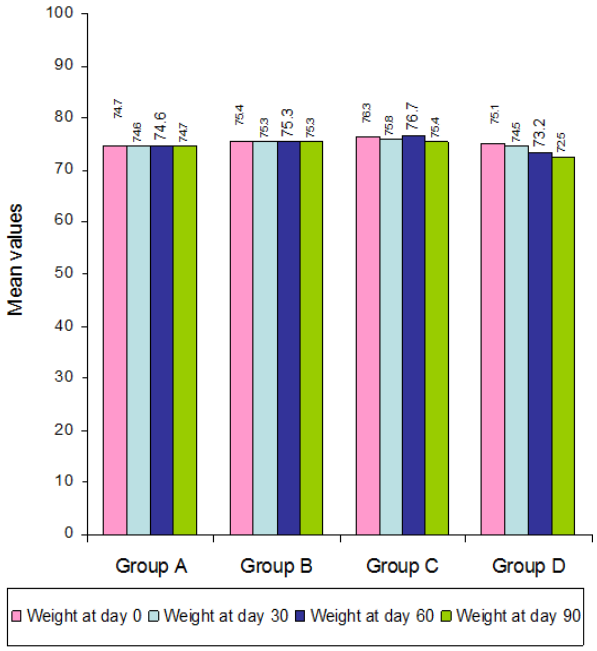

Figure No.1: Comparison of Weight at Day 0, Day 30, Day 60 and Day 90 In Group A, B, C and D

On day 30 total cholesterol wasere significantly decreased in group D (206.2±5.18) as compared to group A (242.4±3.28), group B (227.2±3.14) and group C (230.1±4.88) ($p<0.05$).

On day 60 total cholesterol was significantly decreased in group D (182.3±5.39) as compared to group A (241.8±3.08), B (224.3±3.09) and C (222.8±4.67) $p<0.05$, also cholesterol were significantly decrease in group B (224.3±3.09) and C (222.8±4.67) as compared to group A (241.8±3.08), similarly of day 90 ($p<0.05$)

On day 60 & 90 LDL were significantly decrease in both group C (164.8±5.01), (150.8±5.40) and group D (153.7±8.08), (136.5±8.08) as compared to group A (192.6±9.08), (193.5±9.02) $p<0.05$.

On day 30, 60 and 90 HDL were significantly increased in both groups C (38.8±0.67), (39.4±0.65), (40.2±0.66) and D (40.9±0.56), (42.8±0.88), (41.9±0.93) as compared to group A (35.5±0.50), (35.6±0.51), (35.9±0.55) and B (34.5±0.77), (34.9±0.76), (35.6±0.73) $p<0.05$.

DISCUSSION

Increased physical activity is related to reduced risk of cardiovascular diseases and has impact to prevent the coronary risk factors possibly because it leads to improvement in the lipoprotein profile[10]. Hyperlipidemia is one of the major risk factors for coronary artery disease (CAD) particularly raised low density lipoprotein (LDL-c) and high density lipoprotein (HDL-c)[11]. Research has shown that long-term exercise training improves endothelial function, increases nitric oxide (NO) availability and reduces hypertension in patient with cardio-vascular disease[12,13] Exercise training also induces the expression of antioxidant and anti-inflammatory mediators in the vascular wall that may directly inhibit the development of atherosclerosis[14].

The present study was aimed at observing the effects of light, moderate, and vigorous intensity of 12 weeks exercise program on lipid and lipoprotein levels in 120

hyperlipidemic adults .The selected subjects were divided in four groups A, B, C and D respectively with thirty (n-30) members in each group of either sex between the ages of 30 to 50 years without restriction of diet. The selected subjects were advised not to change their dietary and exercise habits.

The baseline characteristics of all participants showed no significant differences among the groups in terms of initial fitness, height, weight, BMI (Body Mass index), systolic and diastolic blood pressure and total lipid, triglyceride, LDL-c and HDL-c in groups A, B, C and D ($P > 0.05$). The subjects of group A (control group), did not show any change in blood pressure, weight and in lipid profile on baseline till end of the training program of 12 weeks ($P > 0.05$)

In this study the light intensity exercise dose not act as an effective measure to reduce the total cholesterol, triglyceride, LDL-c and HDL-c, indicating that light intensity exercise of such a brief period may have no beneficial effects and is not effective to bring the lipid and lipoprotein levels under the desirable limits. In contrast the study correlates with an other study done by Chaudry *et al*[15] who evaluated that the light intensity aerobic training may improve the profile of HDL-C and its subfractions in elderly subjects and he noticed a significant reduction in triglyceride, LDL-c and total cholesterol concentration.

The results of the present study are in strong agreement with the Elliott *et al*[16] who observed that eight weeks training did not result in any significant alteration in blood lipid profiles.

A decrease in triglyceride was observed in the present study in moderate intensity exercise (Group-C), along with the decrease in LDL-c on day 60, as compared to day 0, and further decrease on day 90, as compared to day 0 and day 30.

HDL-c was observed to be increased progressively on day 30, 7.5%, on day 60, 9.3 % and on day 90, 11.4% and similar results were observed by Chaudhary *et al*[15] who showed the positive correlation in lowering circulating the levels of triglyceride, LDL-C, and total cholesterol in moderate intensity aerobic exercise.

Leon and Sanchez[17], observed reduction in total cholesterol, LDL-c and triglyceride which may occur with training and similar response in men and women and he also noticed that sex and age are not the predictor of lipids responsiveness to exercise and the most frequent change was an increase in HDL-c, a protective factor against CHD. It is estimated that for every 0.026mmol/L (1 mg.dL) increase in HDL-c, the risk for a CHD event is reduced by 2% in men and at least 3% in women[18]. In general a 1% reduction in LDL-c is associated with 2-3% lower risk of CHD (national education program).

In this study there was a profound decrease in various fractions of serum lipids, in subjects of group D (vigorous intensity exercise group) such as triglycerides, total cholesterol, serum LDL-c, but there was tremendous progressive increase in serum HDL-c (15.1% , 20.2% and17.2% on day 30, 60 and 90).

Shirazi[19] in his study he observed overall 40% reduction in total cholesterol and16% elevation in HDL-c. Increased level of HDL-c more than 40mg/dl is cardioprotective and provides significant protection against CAD.

The results of this study suggest that vigorous exercise is much more effective and beneficial in lowering total cholesterol, LDL-c, triglyceride and very much effective in increasing HDL-c.

The study of Kraus et al[10] in which they demonstrated that regular exercise and the degree of improvement in the lipoprotein profile, with the higher amount of exercise having a much greater beneficial effect on lipids and lipoproteins than the lower the amount of exercise. An other study done by Swain and Franklin[20] illustrated that most clinical trials generally found that greater relative intensities result in greater improvement in aerobic fitness and in selected CHD risk factors.

CONCLUSION

In conclusion light intensity exercise does not improve the lipid and lipoprotein levels but moderate intensity exercise is beneficial for lowering the triglyceride, LDL-c and increasing HDL-c levels. In the view of present study vigorous intensity exercise is much more beneficial and effective in bringing lipid and lipoprotein levels towards the lower limits in hyperlipidemic adults.

Recommendation: (1) Physical exercise should be made a lifelong activity to optimize health related benefits. (2) Moderate to vigorous intensity exercise of 30-60 minutes for 5 days a week regularly may be recommended to get favorable changes and beneficial results in hyperlipidemic adults and in most of the CHD risk factors in local population.

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