Original Article

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Effect of Exercise Intensity on Lipid Profile in Sedentary Obese Adults

Physiology Section

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ABSTRACT

Background: Exercise is a lifestyle change that has been recommended for lowering atherogenic index in adults. The intensity and duration of exercise to bring about a change in the lipid parameters are yet to be determined. Previous studies examining the effects of exercise intensity on lipid and lipoprotein levels have reported conflicting findings. Thus we aimed at determining the changes in lipid profile in sedentary obese adults influenced by different intensity of exercise.

Methodology: Study included 51 obese adults with sedentary lifestyle. Participants performed exercise of moderate intensity (n=22) and high intermittent intensity (n=29) for a duration of 40min/day for 5 days/week and 20 min/day for 3 days/week respectively on bicycle ergometer for a period of 15 weeks.

Outcome Measures: Pretesting and post testing included measurement of height, weight, blood pressure and lipid profile.

Statistical Analysis: Results were analysed using the Paired and Unpaired samples t-test.

Results: Postexercise revealed significant reduction in the LDL-C and diastolic blood pressure ($p<0.05$) with the high intensity exercise group.There was a significant difference in BMI, lipid profile and blood pressure in both the moderate and high intensity exercise group.

Conclusion: This study suggests that exercise is "elixir" for a healthy life. High intermittent intensity can be considered for individuals who have time constraints and lead a sedentary life style and moderate intensity exercise advised for individuals who are willing to create time for their health benefits. A programmed protocol of exercise will help in reduction of lipid parameters.

Keywords: Exercise, High intensity, Lipid, Moderate intensity

INTRODUCTION

Physical inactivity is a state of concern as it leads to major health problems like obesity, hypertension and various metabolic disorders. Exercise is recommended as a therapeutic lifestyle change as it leads to various health benefits. It is also known to bring about changes in lipid parameters. The important factors that have to be considered during an exercise session are its intensity and duration which has to be determined to produce major health benefits. Low intensity exercise done for longer periods uses fat as the substrate for energy whereas high intensity exercise uses carbohydrate rather than fat.This finding has led to the recommendation that traditional low to moderate intensity exercise is beneficial to produce changes in lipid parameters compared to high intensity exercise as observed by few studies [1-3]. Recently high intensity intermittent exercise has been highlighted for the purpose of weight reduction and lowering atherogenic index [4,5]. The advantages of high intensity exercise which has been stated is the shorter duration of activity, and as observed by Abby et al., [6] the better long term adherence rate. Conflicting results exist that suggests high intensity exercise and few recommending low to moderate intensity exercise for improving the lipid, lipoprotein levels and blood pressure.Therefore, we aimed at evaluating the effect of exercise on lipid values and blood pressure in sedentary obese individuals and to compare the effects of moderate and high intermittent intensity exercise on these parameters.

METHODOLOGY

The study was conducted in the Department of Physiology at Indira Gandhi medical college, Puducherry, India during the period from September 2011 to June 2012 after obtaining clearance from research and ethical committee. All procedures followed were according to revised Helsinki Declaration of 2000.

Seventy (this number includes drop outs) overweight individuals, staff, students of our college and relatives of patients attending various Out-patient Department of Indira Gandhi medical college and hospital in the age group of 19-35 years, who volunteered for the study, were selected randomly by lot method. Information pamphlet regarding the study was given and informed consent was taken from the volunteers who wished to participate in the study. Sedentary obese individuals Body mass index (BMI≥25) in the age group of 19-35 were included in the study. Individuals with history of previous surgery, diabetic, hypertensive, asthmatics, cardiopulmonary and musculoskeletal disorders were excluded. Complete clinical examination, ECG and echocardiogram were taken and fitness obtained from physician before volunteers were recruited for exercise. Blood sample was taken after overnight fast of 12hrs for lipid profile and estimated using standardised enzymatic methods [7]. A digital weighing scale that could measure to the nearest 0.1kg was used to record weight, and height was measured to the nearest centimeter using a stadiometer, in the Frankfurt plane position. Body mass index (BMI) was calculated based on Quetelet index [8], Blood pressure was recorded using mercury sphygmomanometer with the subject in sitting posture. Subjects were instructed to abstain from caffeine and alcohol at least two days prior to the exercise session and to have food two hours prior to the exercise session. During the visit to the laboratory, subjects were acquainted well with the exercise protocol for two weeks and encouraged to get their doubts clarified. Exercise was performed on the bicycle ergometer at the fixed weight to reach the calculated target heart rate using karvonen formula [9]. Nineteen volunteers opted out due to following reasons, 12 could not come to the department out of the working hours (they were willing to continue the exercise at home), four had shift duties at their office (could not come to the department during night duties), one became pregnant and two lost contact.

Exercise protocol for moderate intensity exercise group included performance of Steady state cycling at the heart rate of 50% -74%

Variables	Baseline values Mean±SD	After exercise Mean±SD
BMI*	29.6±2.4	28.3±2.4
Total Cholesterol*	179.2±30.8	171.1±33.1
LDL Cholesterol*	120.3±28.5	115.7±28.1
HDL Cholesterol*	34.08±3.9	36.7±4.4
VLDL Cholesterol*	22±4.6	18.8±4.6
Triglycerides*	110.8±23.8	101.5±25.3
Systolic blood pressure*	129.5±10.9	122.69±9.9
Diastolic blood pressure*	81.5±6.0	76.3±5.1

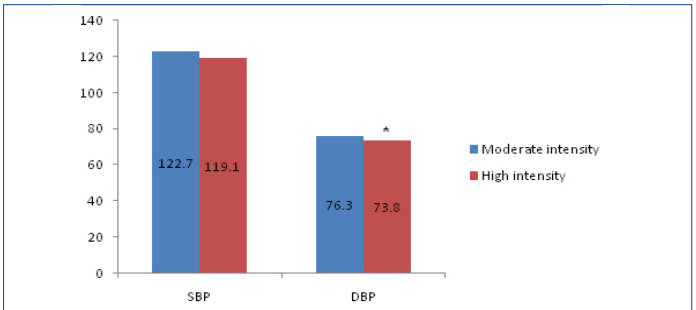
[Table/Fig-1]: Comparison of BMI, lipid parameters and blood pressure before and after moderate intensity exercise
*p-value <0.05 (Level of significance)

Variables	Baseline Values Mean±SD	After exercise Mean±SD
BMI*	29.1±2.7	28.1±2.7
Total Cholesterol*	167.9±22.9	152.5±19.4
LDL Cholesterol*	113.3±19.5	96.4±15.8
HDL Cholesterol*	35.14±5.6.6	36.9±5.1
VLDL Cholesterol	21.7±10.5	17.3±4.9
Triglycerides	101.1±31.2	85.4±24.4
Systolic blood pressure*	125.8±11	119.1±9.2
Diastolic blood pressure*	80±5.1	73.9±3.8

[Table/Fig-2]: Comparison of BMI, lipid parameters and blood pressure before and after high intensity exercise
*p-value <0.05 (Level of significance)

Variable	Moderate intensity	Severe intensity
BMI*	1.2±0.3	1.0±0.2
Total Cholesterol	7.9±8.3	15.4±11.3
LDL*	4.6±6.7	16.8±6.6
HDL	2.7±2.9	1.8±4.4
VLDL	3.23±2,2	4.4±11.3
Triglycerides	9.38±11.2	15.7±36.5

[Table/Fig-3]: Comparison of change in lipid levels and BMI between moderate and severe intensity exercise groups
*p-value <0.05 (Level of significance)



[Table/Fig-4]: Comparison of Blood pressure between moderate and severe intensity exercise groups *p value <0.05 (Level of significance)

of heart rate maximum reserve for a duration of 40 min, 5days/week and High intensity exercise group performed 8sec sprint cycling on bicycle ergometer at the heart rate of 75% -84% of heart rate maximum reserve followed by 12 sec of low intensity cycling for a duration of 20min , 3times/week with 5min of warm up and 5 min of cool down in both the groups.

Lipid profile, height and weight, blood pressure were recorded after 15 weeks of completion of exercise on the 3rd or 4th day after completion of exercise.

RESULTS

Seventy (this number includes drop outs) obese individuals with sedentary lifestyle volunteered to participate in the study. Of this 51 completed the exercise protocol for a period of 15 weeks. They were grouped into moderate intensity exercise group (n=22) and high intensity exercise group (n= 29). The mean ages of the participants were 24.5±5 and 23.6±6 in the respective groups. The gender distribution was 54.5% males, 45.5% females in the moderate intensity group and 55.2% males and 44.8% females in the severe intensity groups The BMI and lipid parameters in both the groups before exercise were similar. [Table/Fig-1] shows the significant changes ($p<0.05$) in lipid parameters, body mass index and blood pressure before and after moderate intensity exercise. BMI and Lipid levels and blood pressure showed a significant change in the high intensity exercise group except very low density lipoprotein – cholesterol (VLDL – C) and Triglycerides as in [Table/Fig-2]. Comparing the lipid parameters between the two groups there was a significant change in the low density lipoprotein - cholesterol (LDL-C) ($p<0.05$) in the high intensity exercise group. BMI showed a reduction in the moderate intensity exercise group as represented in [Table/Fig-3]. The mean Systolic and diastolic blood pressure was 129.5±10.9, 81.5±6.02 and 125.8 ±10.9, 80±5.1 respectively before start of exercise protocol that did not show any significance whereas there was a significant change in the diastolic blood pressure in the high intensity group after 15 weeks of exercise as shown in [Table/Fig-4].

DISCUSSION

Exercise is a subset of physical activity defined as “planned, structured, and repetitive bodily movement done to improve or maintain one or more components of physical fitness.” Physical activity is an important determinant of energy expenditure and regular exercise is essential for weight control and weight loss. The awareness about complications of obesity and the significance of exercise in reduction of cholesterol levels are becoming popular amongst people that are obvious with increase in the number of people walking for health, moving towards gyms and various physical activities. Even the National program for prevention and control of diabetes and cardiovascular disease suggests moderate to vigorous activity for 5-7days/week [10].

The response of the lipid profile to an exercise session or training program is dependent on the type of exercise undertaken, its intensity and frequency, the duration of each session, and the time spent on such a program [11]. Conflicting results exist suggesting one form of exercise as superior to another. Few Studies have observed a decrease in total cholesterol and LDL- C after six months of higher but not lower intensity exercise [12] and an interval training program on hypertensive patients exercising at 60-79% Heart rate (HR) max reserve program of between 45 minutes and 60 minutes at a work/ rest ratio of 1:1 revealed a significant change in Systolic Blood pressure (SBP), Diastolic Blood pressure (DBP), Total Cholesterol (TC), High density lipoprotein (HDL) level [13]. These results are in favor of high intensity exercise, whereas 21 weeks of high intensity exercise in 45-60yr old failed to attain changes in the Total cholesterol, LDL- C and triglycerides [14] and as observed by Benson et al., [15] who did not find significant differences on cardio-metabolic factors HDL-C, LDL-C, Total cholesterol, triglycerides, TC/HDL, between the intervention and control group, after a 8-week high-intensity progressive resistance program twice a week. Studies [16] comparing aerobic and resistance exercise have observed a significant changes in VLDL and HDL in both groups and changes only with aerobic exercises observed by Chaudhary et al., [17]. There is lacuna as to which type and intensity of exercise would be sufficient to produce a remarkable change in the cardiovascular metabolic profile.

From our results, comparing moderate and high intensity exercise LDL- C levels showed a statistical significant reduction in the high intensity group. The reason for this could be due to the fact that energy expenditure is more with the high intensity exercise during recovery period. Though fat provides more Kcal of energy/gm than

carbohydrate, fat oxidation requires more oxygen than carbohydrate oxidation, so excess postexercise oxygen consumption requires several min for moderate intensity exercise and several hours for high intensity exercise [18].

We suggest that high intensity exercise is relatively safe and can be slowly introduced in obese individuals. Resistance exercises require supervision, guidance and the need to increase the repetitions to maintain the required heart rate, whereas this study protocol once acquainted requires minimal supervision. It is simple to follow and performing high intermittent intensity exercise results in only 8 minutes of exercise at maximum intensity and 12 minutes of low intensity exercise per session, making it a time efficient method of exercise compared to protocols followed in other studies.

The common prescription for hypertensive and diabetic individuals is walking for approximately 30 min and there is a dearth of awareness regarding high intensity intermittent exercise. There is also a belief that high intermittent intensity exercise is harmful for hypertensive patients. Our results show that Systolic and Diastolic blood pressure are significantly lowered after both types of exercise in accordance to study by Purvi et al., [16] and only in aerobic training group as observed by Chaudhary et al., [17]. Examining the SBP and DBP between the two groups there is a significant reduction with DBP in the high intensity group. These changes may be because of favorable changes in vascular compliance due to release of hormones that could reduce peripheral resistance. More studies examining the effects of high intermittent intensity exercise in hypertensive patients is the need of the hour.

A 10% reduction of Total cholesterol reduces risk of coronary artery disease mortality by 13% and 1% reduction of LDL-C reduces risk of major coronary events by approximately 2% [19].

Our finding of decrease in total cholesterol and an increase in HDL-C in both the groups is consistent with previous results of Fahri et al., and Kraus et al., [3,14]. However, not all studies have found change in lipid parameters. Rad et al., [20] have demonstrated that weight loss mostly was due to combined effects of exercise and diet and exercise alone was insufficient to stimulate change in any lipid or lipoprotein measures. The only dietary advice given to our subjects was to take dinner 1-2 hrs before going to bed which is a limitation of this study and long term studies examining the effects of diet and exercise intensity on cardiovascular metabolic factors are required.

Comparison of lipid parameters and BMI within the groups showed significant changes in total cholesterol, LDL-C, HDL-C, TGL, VLDL in the moderate intensity group and changes in total cholesterol, HDL-C, LDL-C and BMI in the high intensity group. Exercise should not only target on weight loss but should also be efficient in lowering atherogenic index. Therefore, we suggest high intensity exercise over moderate intensity exercise for people who have time constraints.

The importance of exercise has been emphasised in our study and it has been suggested that exercise prescription should be based on the health and fitness levels of the individual. It should be progressively introduced to individuals who are relatively sedentary and overweight. Instead of using lifestyle modification as a treatment measure after the onset of the disease, approach to weight reduction and improvement in cardiovascular fitness should include physical activity and diet modification which was a limitation of this study. Long term studies are required to confirm these findings.

CONCLUSION

High intensity intermittent exercise which can be done for 15 – 20 min for 3-4 days/week has produced a significant change in the LDL C and a reduction of diastolic blood pressure. Moderate intensity exercise is efficient in reducing the BMI. Both forms of exercise have shown a significant change in the cardio metabolic profile. In summary, high intensity exercise of short duration can be performed during the active stage of life instead of complaining about lack of time and moderate intensity exercise can be suggested to people who show interest and are willing to create time for their exercise protocol. More long term studies are required to explore the benefits of high intermittent intensity exercise.

REFERENCES

[1] Evangelia M, Kouidi N, Koutlianos N, Deligiannis A. Effects of long-term exercise training on cardiac baroreflex sensitivity in patients with coronary artery disease: a randomized controlled trial. *Clin Rehabil*. 2010. 0269215510380825.
[2] Nikam S, Nikam P, Joshi A, Viveki RG, Halappanavar B, Hungund B. Effect of Regular Physical Exercise (Among Circus Athletes) on Lipid Profile, Lipid Peroxidation and Enzymatic Antioxidants. *International Journal of Biochemistry Research & Review*. 2013;3(4): 414-20.
[3] Ardoyl DN, Artero EG, Ruiz JR, Labayen I, Sjostrom M, Castillo M, et al. Effects on adolescents' lipid profile of a fitness-enhancing intervention in the school setting: the EDUFIT study. *Nutr Hosp*. 2013;28:119-26.
[4] Kraus WE, Houmard JA, Duscha BD, Knetzger KJ, Wharton MB, Mccartney JS, et al. Effects of the amount and intensity of exercise on plasma lipoproteins. *N Eng J Med*. 2002;34:1483-92.
[5] Sandvei M, J eppesen PB, Støen L, Litleskare S, J ohansen E, Stensrud T, et al. Sprint inter val running incr eases insulin sensitivity in young healthy subjects. *Arch Physiol Biochem*. 2012;118(3):139-47.
[6] Abby CK, William IH, Deborah RY, Roberta KO, Marcia IS. Long-term effects of varying intensities and formats of physical activity on participation rates, fitness, and lipoproteins in men and women aged 50 to 65 years.*Circulation*.1995;91:2596-2604.
[7] Carl A Burtis ,Edward R Ashwood, David E Bruns. Tietz Fundamentals of clinical chemistry. 6th ed.USA:Elsevier Saunders; 2008. chap 23, Lipids, Lipoproteins, Apolipoproteins and other cardiovascular risk factors; p. 402-30.
[8] Eknoyan, Garabed. AdolpheQuetelet (1796–1874)—the average man and indices of obesity. *Nephrol Dial Transplant*. 2008; 23 (1): 47–51.
[9] Paoli A, Quirico FP, Tatiana M, Giuseppe M, Marco, Giuseppe B, et al. Effects of high-intensity circuit training, low-intensity circuit training and endurance training on blood pressure and lipoproteins in middle-aged overweight men. *Lipids Health Dis*. 2013; 12: 131.
[10] National Programme for Prevention and Control of Diabetes, Cardiovascular Disease and Stroke. A manual for medical officer. Developed under the Government of India – *WHO Collaborative Programme* 2008-2009.
[11] Cox KL, Burke V, Morton AR, Gillam HF, Beilin LJ, Puddey IB. Long term effects of exercise on blood pressure and lipids in healthy women aged 40-65years:the sedentary women adherence trial (SWEAT). *J Hypertens*. 2001;19:1733-43.
[12] Sillanpaa E, Hakkinen A, Punnone K, Laaksonen DE. Effects of strength and endurance training o metabolic risk factors in healthy 40-65 year old men. *Scand J Med Sci Sports*. 2009; 19: 885-95.
[13] Lamina S, Okoye GC. Therapeutic effect of a moderate intensity interval training program on the lipid profile in men with hyper tension: a randomized controlled trial Niger *J Clin Pract*. 2012; 15(1): 42-47.
[14] Fahri A. Changes in serum lipid profile following moderate exercise. Afr. *J.pharm*. pharmacol. 2010; 4(11): 829-33.
[15] Benson AC, Torode ME, Fiatarone Singh MA. The effect of high-intensity progressive resistance training on adiposity in children: a randomized controlled trial. *Int J Obes* (Lond). 2008; 32: 1016-27.
[16] Purvi K Changela. A Study to Compare the Effect of Aerobic and Resistance Training on Cardiovascular (CVS) Fitness in Young Obese Sedentary Females. *Ijsrp*. 2013; 3(2) . 1-8.
[17] Chaudhary S, Kang MK, Sandhu JS. The Effects of Aerobic Versus Resistance Training on Cardiovascular Fitness in Obese Sedentary Females. *Asian Journal of Sports Medicine*. 2010; 1(4): 177-84.
[18] Jack H Wilmore, David L Costill. Prescription of exercise for health and fitness. 3rdedi. Hongkong Physiology of sports and exercise; Chapter 19. *Human kinetics*. P. 620.
[19] Martins RA, Verissimo MT, Silva MJ, Cumming SP, Teixeira AM. Effects of aerobic and strength-based train-ing on metabolic health indicators in older adults. *Lipids in Health and Disease*. 2010; 9: 76.
[20] Rad S, Gholami M. Impact of exercise training and/or diet on the lipoprotein–l ipidprofiles in young overweight women. *Br J Sport s Med*. 2010; 44: i20.

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