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HIGH DENSITY LIPOPROTEIN AND PHYSICAL FITNESS: DO THEY GO HAND IN HAND?

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ABSTRACT

Background: Exercise is the first line of treatment used to improve the lipid profile of a person. Lack of exercise will lead to a host of chronic illnesses. **Aim:** This study compares lipid profile levels of apparently healthy, regularly exercising young adults with those who did not exercise regularly. **Settings and Design:** Christian Medical College, Ludhiana; Comparative study. **Methods:** The lipid profile of a cohort of 24 subjects who had been indulging in regular physical activity for 6 months prior to sample collection were compared with 24 subjects who did not exercise. Roche modular P800 was used. Selection was done by simple convenient sampling. Data of their physical activity was collected with the help of global physical activity questionnaire. Statistical analysis was done by ANOVA analysis. **Results:** Those engaging in vigorous physical activity of 3-4 h/week had an effective increase in high density lipoprotein cholesterol (HDL-C) of 10, more than those who did not do any vigorous physical activity at all (P = 0.005). There was no additional benefit when exercise was increased to more than 4 h. Those who indulged in regular vigorous physical activity were also more active in other aspects of their day-to-day life. Regularly exercising group spent slightly less time being physically inactive during the day. HDL-C decreased in both groups when they were physically inactive for more than 6 h/day (sleep excluding). **Conclusions:** Our study clearly shows that regular exercisers had improved level of HDL-C. HDL-C and physical fitness go hand-in-hand.

Key words: Exercise, High density lipoprotein-C, Lipid profile

INTRODUCTION

High level of high density lipoprotein cholesterol (HDL-C) reduced the risk of heart disease, and is often contrasted with low density lipoprotein cholesterol (LDL-C).[1] Cardiovascular disease (CVD) is the most common contributor of morbidity and mortality worldwide. The Global Status on Non-Communicable Diseases Report (2011) has observed that there were more than 2.5 million deaths due to CVD in India in 2008; two-thirds of the deaths were due to coronary heart diseases and one-third is due to stroke. These estimates are significantly greater than those reported by the Registrar General of India, and it shows that CVD mortality is rapidly increasing.[2] The Indian community is showing a change in dietary patterns with the traditional complex carbohydrate-rich diet being replaced by refined food with increased proportion of fats.[3]

American Heart Association found that CVD caused 1/6th of all deaths.[4] In the United States, 34% of adults currently meet the criteria for the metabolic syndrome defined by elevated waist circumference, plasma triglycerides (TG), fasting glucose and/or blood pressure, and decreased HDL-C. While these cardio metabolic risk factors can be treated with medication, lifestyle modification is strongly recommended as a first-line approach. Recent studies have suggested that when compared with continuous moderate exercise, high-intensity interval training (HIT) may result in improved physical fitness and cardiovascular health. A minimum duration of 8 weeks of HIT was necessary to demonstrate improvement in HDL-C in three of ten studies.[5]

Reverse cholesterol transport describes the transfer of cholesterol from non-hepatic cells to the liver. Cholesterol taken from cell membrane is converted to cholesteryl esters (CE) by lecithin-cholesterol acyl-transferase. CE being non polar readily moves to the core of HDL particle, thus enabling HDL to accept cholesterol from various cell donors.[6]

High density lipoprotein cholesterol also known as "good cholesterol," is the smallest lipoprotein which transports cholesterol and TG in blood. HDL-C particles are able to remove cholesterol from within an artery atheroma and transport it back to the liver for excretion or re-utilization. HDL-C also has diverse anti-inflammatory actions in both endothelial cells and leukocytes. HDL-C is antithrombotic. There are additional actions of HDL-C of potential cardiovascular consequence that

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are indirect, it promotes pancreatic β-cell insulin secretion, protects pancreatic β cells from apoptosis, enhances glucose uptake by skeletal muscle myocytes. Furthermore, HDL-C decreases white adipose tissue mass, increases energy expenditure, and promotes the production of adipose-derived cytokine adiponectin that has its own vascular-protective properties.[7]

A generally accepted approach is to define physical fitness as the ability to carry out daily tasks with vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies.[8] Physical fitness definition by Howley and Frank is a state of well-being with low risk of premature health problems and energy to participate in a variety of physical activities. Physical activity is any form of exercise or movement of the body that uses energy.[9]

Physical activity may influence physical fitness, which in turn may modify the level of physical activity. With increasing fitness, people tend to become more active, and the fittest persons tend to be the most active. The association between fitness and health is also reciprocal. Fitness influences health, but health status also influences both physical activity and fitness.[10]

Physical fitness is associated with a decreased risk of CVD, which may be partly caused by the effect of exercise on the lipid profile. The most consistent effect of exercise on lipoprotein metabolism is an increase in HDL.[11]

In this study we evaluated and compared the HDL-C levels of apparently healthy males and females between the age group of 20-35 years by dividing them into two groups as the ones who exercised regularly for the last 6 months and the control group consisted of those who were not exercising routinely.

MATERIALS AND METHODS

In this comparative study blood samples were collected from subjects between the age groups of 20-35 years after taking their informed consent. A cohort of 24 subjects who have been indulging in regular vigorous/ moderate physical activity for 6 months prior to sample collection were compared with 24 subjects who did not exercise during the same period. Both groups were selected by simple convenient sampling and were age and gender matched.

Inclusion criteria

The study consisted of young, apparently healthy adults, with no chronic illness between the age group of 20-35 years.

Exclusion criteria

Subjects on diet intervention or on drugs, which alter the lipid profile. Individuals having medical problems like diabetes, hypertension and CVD.

Collection and processing of samples

The samples were collected between 8 and 10 am in sitting position. It was collected from the antecubital vein. About 5 ml blood was collected, and it was allowed to be clotted. It was centrifuged and the test was analyzed in serum samples on fully automated Roche modular P800 immediately after serum was separated.

The WHO validated global physical activity questionnaire was used to collect data of the subjects physical fitness regarding their work, leisure time activity and daily mode of transport used to cover short distances. The duration of physical activity (time per week) and the intensity of the sport activity was also recorded. Intensity of exercise was graded into qualitative terms such as vigorous (running/football) and moderate (cycling, swimming, volleyball, brisk walking etc.). Their HDL-C was co-related with the level of physical fitness.

RESULTS

Results were expressed as mean. Comparison of mean values of study groups was performed by ANOVA. To find the intergroup difference Bonferroni *post-hoc* test was performed. Significance level was kept at 0.05. When the whole population was analyzed with amount of hours of vigorous activity per week, it was observed 3-4 h/week is statistically significant to no vigorous activity at all (ANOVA Analysis, Bonferroni's $P = 0.005$). However, more than 4 h/week also was found to be significant but it was not as significantly high as with 3-4 h/week.

HDL-C is regular exercisers and non exercisers is given in Tables 1 and 2. Significance of HDL-C in vigorous activity is compared to those with no vigorous activity in Table 5. HDL-C/cholestrol ratio in both the groups was calculated seperately for males and females and depicted in Graph 1-3.

Table 1: HDL in regular exercisers

Group	Mean	Median	Standard deviation	Min	Max
HDL-C	51.7	49.5	9.6	30	68
CHOL	175.2	182.5	31.7	111	222

HDL-C: High density lipoprotein cholesterol, CHOL: Cholesterol

Table 2: HDL in nonexercisers

Group	Mean	Median	Standard deviation	Min	Max
HDL-C	43	42.5	10.2	27	65
CHOL	170.8	175	25.7	124	225

HDL-C: High density lipoprotein cholesterol, CHOL: Cholesterol

Table 3: Demographic features of test and control group

Gender	Regular exercisers	Nonexercisers
Males	18	18
Females	6	6
Total	24	24

Out of the total number included in the study males consisted of 75% and the rest were females

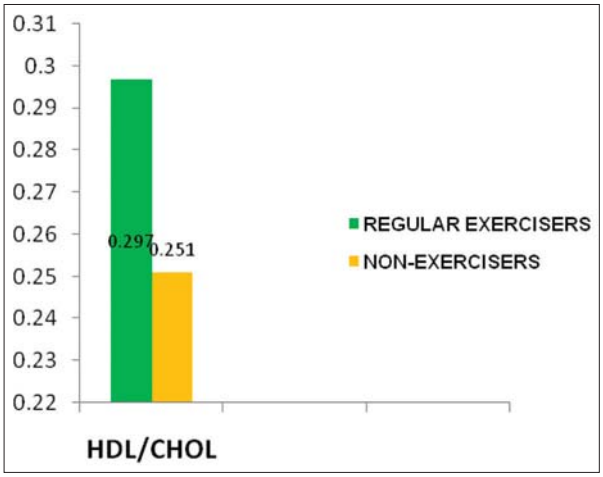
Table 4: Distribution of different modes of activity between both the groups

Hours/week spent in moderate activity	Groups	Mean	Standard deviation
Bicycle (h/week)	Exercisers	0.33	1.231
	Nonexercisers	0.04	0.204
Walk (min/day)	Exercisers	50.63	26.35
	Nonexercisers	39.38	15.35
Vigorous activity (h/week)	Exercisers	3.75	2.56
	Nonexercisers	0.0	0.0
Moderate activity (h/week)	Exercisers	4.25	2.38
	Nonexercisers	0.0	0.0
Sit/reclining (h/day)	Exercisers	4.02	1.79
	Nonexercisers	4.17	2.38

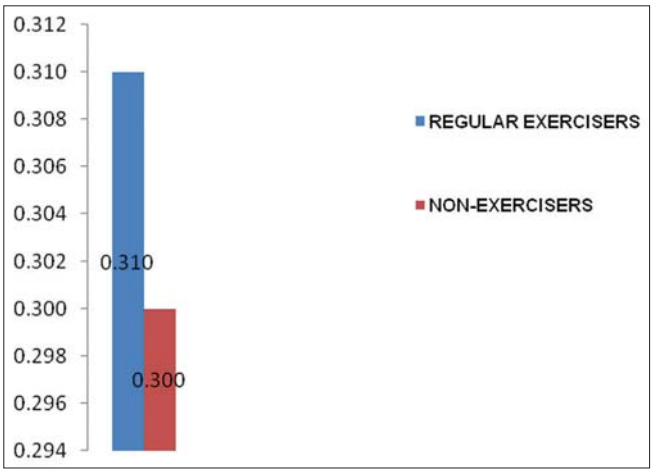
Table 5: Significance of HDL-C in vigorous activity in hours/week in comparison to those with no vigorous activity

Time spent in vigorous activity in exercisers	Mean difference of increase in HDL-C in exercisers versus non exercisers
3-4 h/week	−10.4
5-6 h/week	−10.9

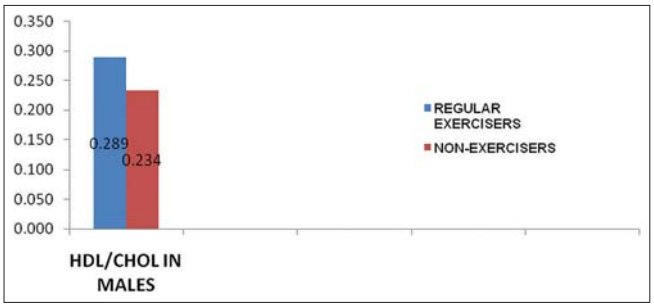
HDL-C: High density lipoprotein cholesterol



Graph 1: High density lipoprotein cholesterol/cholesterol (HDL/CHOL) ratio in both the groups. (HDL/CHOL in regular exercisers is 0.297 and in nonexercisers group is 0.251)



Graph 2: High density lipoprotein cholesterol/cholesterol (HDL/CHOL) in females of both groups. (HDL/CHOL ratio in regular exercising females was 0.310 and in nonexercisers is 0.300)



Graph 3: High density lipoprotein cholesterol/cholesterol (HDL/CHOL) in males of both groups. (The HDL/CHOL ratio in males exercising group was 0.289 and in nonexercising group was 0.234)

DISCUSSION

The present study evaluated the physical fitness by taking into consideration the average time spent exercising and also in other day to day activities. The exact amount of time spent every day in exercise, walking, bicycling could not be accurately recorded. Other factors effecting HDL-C levels like diet, weight, alcohol consumption, genetic variations determining HDL-C etc., were not taken into consideration. Table 4 shows there is a mean difference of HDL-C levels in regular exercisers, when they exercised for 3-4 h was 10

units higher when compared to regular non-exercisers. Caro *et al*. 2013 have reported the similar results of increase in HDL-C in regular exercisers when compared to non-exercisers.[12]

Being physically fit helps avoid premature health problems. HDL-C is one of the parameters used to assess the atherogenic index. Exercise used as an intervention for patients at risk for cardiovascular events can lead to small improvements in HDL-C and potential changes in HDL function.[13]

In this study regular exercisers had a mean lower level of cholesterol when compared to non-exercisers, it was not statistically significant. In the recent years some studies have observed no significant difference in lipid profile with exercise. Arsenault *et al*. did not see any changes in lipid profile in healthy but overweight postmenopausal women[14] and Ribeiro *et al*. observed that HDL efficiently lowered LDL oxidation but showed no improvement in cholesterol level.[15]

In this study it was also observed that those who indulged in regular vigorous physical activity were also more active in other aspects of their day to day life, be it in travel place to place, recreational or work which improved physical fitness. The regularly exercising group spent slightly less time being inactive during the day than the non-exercisers. HDL-C decreased in both groups when they were physically inactive for more than 6 h/day. Hence regular exercise improves the overall physical fitness and physical activity.

CONCLUSION

The present study clearly shows HDL-C and physical fitness go hand in hand, in improving the overall health. However other factors like atherogenic, diet should be taken into consideration for proper justified conclusion.

REFERENCES

1. Toth PP. Cardiology patient page. The "good cholesterol": High-density lipoprotein. Circulation 2005;111:e89-91.
2. Gupta R, Guptha S, Sharma KK, Gupta A, Deedwania P. Regional variations in cardiovascular risk factors in India: India heart watch. World J Cardiol 2012;4:112-20.
3. Kaul U. Cardiovascular disease epidemic in India – A continuing problem. J Assoc Physicians India 2012;60:9.
4. Roger VL, Go AS, Lloyd-Jones DM, Benjamin EJ, Berry JD, Borden WB, *et al*. Executive summary: Heart disease and stroke statistics – 2012 update: A report from the American Heart Association. Circulation 2012;125:188-97.
5. Kessler HS, Sisson SB, Short KR. The potential for high-intensity interval training to reduce cardiometabolic disease risk. Sports Med 2012;42:489-509.
6. Assmann G, Gotto AM Jr. HDL cholesterol and protective factors in atherosclerosis. Circulation 2004;109:III8-14.
7. Mineo C, Shaul PW. Novel biological functions of high-density lipoprotein cholesterol. Circ Res 2012;111:1079-90.
8. Ardern CI, Katzmarzyk PT, Janssen I, Leon AS, Wilmore JH, Skinner JS, et al. Race and sex similarities in exercise-induced changes in blood lipids and fatness. Med Sci Sports Exerc 2004;36:1610-5.
9. Davidson S, Passmore R, Brook JF, Truswell AS. Human Nutrition and Dietetics. 7th ed. New York: Churchill Livingstone; 1979.
10. Tammelin T, Näyhä S, Laitinen J, Rintamäki H, Järvelin MR. Physical activity and social status in adolescence as predictors of physical inactivity in adulthood. Prev Med 2003;37:375-81.
11. Spady DK. Reverse cholesterol transport and atherosclerosis regression. J Clin Invest 1990;86:379-84.
12. Caro J, Navarro I, Romero P, Lorente RI, Priego MA, Martínez-Hervás S, et al. Metabolic effects of regular physical exercise in healthy population. Endocrinol Nutr 2013;60:167-72.
13. Blazek A, Rutsky J, Osei K, Maiseyeu A, Rajagopalan S. Exercise-mediated changes in high-density lipoprotein: Impact on form and function. Am Heart J 2013;166:392-400.
14. Arsenault BJ, Côté M, Cartier A, Lemieux I, Després JP, Ross R, et al. Effect of exercise training on cardiometabolic risk markers among sedentary, but metabolically healthy overweight or obese post-menopausal women with elevated blood pressure. Atherosclerosis 2009;207:530-3.
15. Ribeiro IC, Iborra RT, Neves MQ, Lottenberg SA, Charf AM, Nunes VS, et al. HDL atheroprotection by aerobic exercise training in type 2 diabetes mellitus. Med Sci Sports Exerc 2008;40:779-86.

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