

# EFFECT OF EXERCISE ON PLASMA CHOLESTEROL

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## ABSTRACT

**Background:** Coronary artery disease is a major health problem. Hyperlipidemia is one of the major risk factors for it, particularly raised LDL and low HDL cholesterol levels. The aim of this study was to assess the effect of exercise on plasma total and HDL cholesterol in patients with hypercholesterolemia.

**Material and Methods:** This study was carried out in a private clinic at Dera Ismail Khan, Pakistan, from 1st August , 2006 to 31st October, 2006. Eligible patients were adult males with hypercholesterolemia i.e. fasting plasma cholesterol > 200 mg/dl. Patients with coronary artery disease, arrhythmias, valvular heart disease, cardiomyopathy, congestive cardiac failure, concurrent treatment with lipid lowering agents, pregnancy, renal failure, type 1 diabetes mellitus, physical disability or chronic major illness were excluded from the study. All the patients were kept on a National Cholesterol Education Program step I diet. All these patients were given daily exercise program of 60 minutes for one month. Plasma total and HDL cholesterol were measured before and after the exercise program.

**Results:** Ninety one male patients having fasting plasma cholesterol > 200 mg/dl were studied. Mean age of these patients was  $39.5 \pm 8.5$  years. The mean total cholesterol before and after exercise program was  $249.3 \pm 20$  mg/dl and  $152.9 \pm 11$  mg/dl respectively, showing an overall reduction of 40%. The mean HDL cholesterol before and after exercise program was  $38.21 \pm 9$  mg/dl and  $50.75$  mg/dl respectively, showing an overall increase of 16%.

**Conclusion:** Regular exercise effectively reduces the plasma total cholesterol and increases HDL cholesterol in patients with hypercholesterolemia.

**Key words:** Cholesterol, HDL cholesterol, Exercise, Coronary artery disease.

## INTRODUCTION

Coronary artery disease (CAD) is a major health issue, placing a significant burden in terms of morbidity and mortality on the population and in terms of cost on the individual and the public health system. It is the leading cause of death in adults. Hyperlipidemia is one of the major risk factors for CAD,<sup>1</sup> particularly raised Low Density Lipoprotein (LDL) and low High Density Lipoprotein (HDL) cholesterol.<sup>2,3,4,5</sup> It has been shown in many clinical trials that lowering total cholesterol decreases the incidence of myocardial infarction and improves survival in patient with CAD.<sup>6,7</sup>

CAD is multi-factorial in nature. It is the result of interaction between genetics, environment and lifestyle. It is the most important preventable cardiovascular disease and the most important cause of death in the modern world.<sup>8</sup> It is associated with various predisposing risk factors. Framingham heart study and Multiple Risk Factors Intervention Trial (MRFIT) has provided the backbone database for analysis of various risk factors. The major risk factors researched extensively, are hypertension,<sup>9,10</sup> hypercholesterolemia,<sup>1,8</sup> diabetes mellitus,<sup>8</sup> smoking,<sup>9,11</sup> obesity<sup>8</sup> and a family history of CAD.

Physical inactivity or sedentary life style is also considered a risk factor for CAD. Regular exercise results in an increase in exercise capacity and lowers myocardial oxygen demand leading to cardiovascular benefits, including lower mortality rates and fewer occurrence of CAD.<sup>12,13</sup> It is advised that those individuals who are inactive should increase their physical activity gradually. Those who participate in light levels of exercises or who are irregularly active should attempt to exercise more regularly at least at moderate levels. The beneficial effect will depend upon how active the individual is at the base line. For example sedentary people will gain the most followed by moderately active individuals.<sup>12,14</sup>

The aim of this study was to assess the effect of exercise on plasma total cholesterol and HDL cholesterol in patients with hypercholesterolemia.

## MATERIAL AND METHODS

This experimental study was carried out in a private clinic at Dera Ismail Khan, Pakistan from 1st August, 2006 to 31st August, 2006. Eligible

patients were adult males, aged 18-60 years, with hypercholesterolemia i.e. fasting plasma cholesterol  $> 200$  mg/dl. Patients with angina pectoris, myocardial infarction, positive ETT or showing reversible ischemia on thallium studies were excluded. Age more than 60 years, physical disability, Left Bundle Branch Block or paced ventricular rhythm, valvular heart disease, cardiomyopathy, arrhythmias, and chronic major illness were also excluded from the study. Congestive cardiac failure New York Heart Association (NYHA) class III or IV, concurrent treatment with lipid lowering agents, pregnancy, renal failure or type 1 diabetes mellitus were also excluded.

The study was approved by the Local Ethics Committee and a written informed consent was obtained from all the patients at the time of registration. All the patients received instructions and counseling to promote compliance and were kept on a National Cholesterol Education Program step I diet.

All the patients included in the study were given exercise program. The exercise place was allotted according to the patient's convenience; either "jogging track of polo ground" or "River side road". Total duration of exercise was 60 minutes, divided into four segments:

1. Ten minutes warm up period; Normal routine walk.
2. Twenty minutes brisk walk; Patients were asked to walk as fast as possible, short of running.
3. Ten minutes slow moderate running.
4. Twenty minutes normal slow pace walk with deep breaths in relax mood.

Plasma total cholesterol and HDL cholesterol were measured before and after the exercise program for one month.

The data was analyzed using statistical package for social sciences version 10 (SPSS 10). Student's t test and chi-square tests were applied.  $p$  value of  $< 0.05$  was taken as significant.

## RESULTS

In this study 105 male patients having fasting plasma cholesterol level  $> 200$  mg/dl were initially included. Twelve patients dropped out and left the exercise program without any information. Two patients were injured due to motorcycle accidents and could not continue the exercise program. The mean age of these patients was  $39.5 \pm 8.5$  years. Other major risk factors for CAD in these patients are shown in Figure-1; 19 (20.8%) patients had hypertension, 34 (37.4 %) had diabetes mellitus, 29 (31.8%) were smokers and 8 (8.7%) patients had family history of CAD.

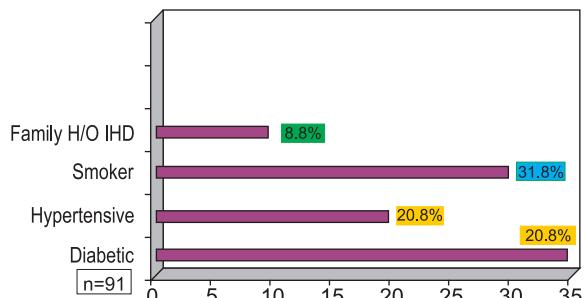


Fig. 1: Showing risk factors in the study population.

The mean plasma total cholesterol in 91 patients before exercise program was  $249.33 \pm 20$  mg/dl and the mean HDL cholesterol before exercise program was  $38.21 \pm 9$  mg/dl. The mean total cholesterol at the end of the study was  $152.9 \pm 11$  mg/dl showing an overall reduction of 40%. This difference was statistically highly significant ( $p < 0.001$ ).

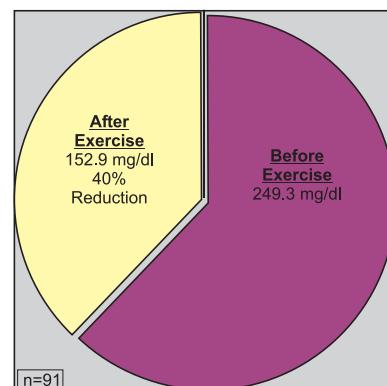


Fig. 2: Comparison of mean total cholesterol level before and after exercise program.

The mean HDL cholesterol in 91 patients before exercise program was  $38.21 \pm 9$  mg/dl and at the end of the study  $50.74$  mg/dl, showing an overall increase of 16%. This difference was statistically highly significant ( $p < 0.001$ ).

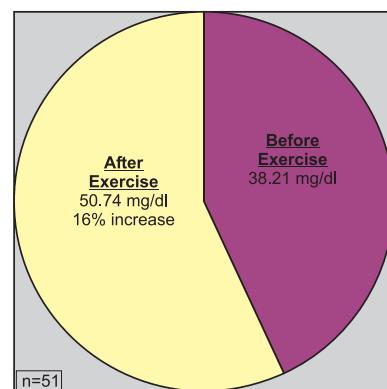


Fig. 3: Comparison of mean HDL cholesterol level before and after exercise program.

Muscular pain and fatigue was reported in only 7 patients. Breathlessness and palpitation was reported in 14 patients particularly in smokers.

## DISCUSSION

An abnormal lipid profile is a well established risk factor for coronary artery disease. Reduction in plasma cholesterol remains the corner stone of treatment to provide safeguard against heart attack and other high cholesterol related events like peripheral vascular disease. Besides lowering the total and LDL cholesterol, the need to raise HDL cholesterol is now widely accepted as a concomitant goal of treatment. Low HDL cholesterol is a powerful risk factor for coronary heart disease.<sup>15,16,17,18</sup> Every 1-2 mg/dl increase in HDL cholesterol is associated with a 2-3% reduction in CAD risk.<sup>20,21,22</sup> High HDL cholesterol is cardio protective irrespective of the level of LDL cholesterol.<sup>14,16,23</sup>

In our study the data of patients with high cholesterol was analyzed to see the effect of exercise in patients with hypercholesterolemia; plasma total cholesterol decreased by 40%, while HDL cholesterol level increased by 16% after the exercise program.

Entire population of patients entered in this study had plasma cholesterol level > 200 mg/dl and HDL cholesterol < 40 mg/dl. These levels are considered to be risk factors for CAD by NCEP-ATP 111 guidelines.

The results of a number of clinical trials on primary and secondary prevention suggest that the degree of cardiovascular events reduction is directly related to the degree of lipid lowering. Data from landmarks studies have shown that reducing total cholesterol by 20-25% decreases the cardiovascular events by about 25-35%. Cholesterol lowering whether by exercise, life style modification or cholesterol lowering drugs has positive impact upon morbidity and mortality.

However it has been shown that cholesterol lowering whether by exercise or drug therapy results in lowering the total cholesterol and increasing the level of HDL cholesterol.<sup>17</sup> This increase in HDL cholesterol is more marked with exercise than drug therapy. Exercise should be recommended for cholesterol lowering purpose. It not only lowers the total cholesterol but the side effects of drug therapy are also avoided.<sup>6,13,17</sup>

Results of the Air Force/Texas coronary atherosclerosis prevention study,<sup>18</sup> the long-term intervention with pravastatin in ischemic disease (LIPID) study<sup>19</sup> and a post hoc analysis of the Scandinavian simvastatin survival study (4S)<sup>6</sup> support the theory that there is no apparent threshold level

below which further lipid lowering would not provide additional benefit.

In heart protection study, in Myocardial Ischemia Reduction with Aggressive Cholesterol Lowering (MIRACL) study and in Prospective Pravastatin Pooling (PPP) Project, the reduction in total cholesterol is reported in the range of 20 to 40 percent but decrease in the level of HDL is only in the range of 10 to 13 percent.<sup>23</sup> In our study the overall reduction in total cholesterol at the end of study is 40% which is quite consistent with most of the clinical trials carried out with statins. However elevation in HDL cholesterol at the end of exercise program is 16% which is more impressive and more pronounced as compared to 10-13% observed in these trials.

It is quite clear from the above discussion that both exercise and drug therapy can lower the cholesterol level quite significantly but exercise has effect upon HDL elevation more pronounced than the drug therapy. In addition the side effects as observed with lipid lowering agents are not a problem with exercise. It is therefore recommended that all the patient having high plasma cholesterol should have exercise on regular basis. Adherence to such practice not only lowers the high total cholesterol but also increases the HDL cholesterol level. HDL cholesterol gives protection against CAD irrespective of the level of other cholesterol.<sup>8,12</sup> Increased level of HDL Cholesterol more than 40 mg/dl is cardioprotective and provides significant protection against CAD irrespective of the level of total cholesterol.

## CONCLUSION

Regular exercise effectively reduces the plasma total cholesterol and increases HDL cholesterol in patients with hypercholesterolemia.

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