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Original Article

# EFFECT OF PHYSICAL TRAINING ON LIPID PROFILE IN HEALTHY, YOUNG MALES: A FOLLOW UP STUDY

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## ABSTRACT

**Background and objective:** Obesity itself is believed to be a morbid condition by many and it is also thought to be a cause of many health problems and chronic diseases like type 2 diabetes mellitus, coronary heart diseases. Regular physical exercise has got many health benefits including its effect on metabolism particularly on lipids. The objective of present study is to assess the effect of exercise training on lipid profile.
**Materials and Methods:** We followed up 40 male students of Physical education aged between 18 to 25 years, for the period of nine months. Those with history of inborn errors of metabolism, those having endocrine disorders, those with diagnosed familial hyperlipidemia are excluded from our study. Their lipid profile parameters were measured in the beginning of exercise training period and then at the interval of every 3 months, with the first reading taken as baseline.
**Result:** when we compared the readings with each other as well as with the baseline reading, we found that the levels of total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL-C) and very Low density lipoprotein cholesterol (VLDL-C) decreased significantly while high density lipoprotein cholesterol (HDL-C) increased as the duration of exercise training period progressed. Significant reduction was also observed in TC/HDL-C ratio as the duration of physical training progressed.
**Conclusion:** Findings of our study suggest that, regular physical exercise has possible effect on improving lipid metabolism as lipid profile improved with increase in duration of exercise training period. Regular physical activity may be associated with decreased risk of chronic diseases like diabetes mellitus type 2, coronary heart disease.
**KEY WORDS**: Exercise training, obesity, lipid profile, chronic diseases.

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## INTRODUCTION

Association between obesity and chronic diseases like diabetes mellitus type 2 and coronary heart diseases is well established [1-5]. Epidemiological data suggests that low concentrations of total serum cholesterol and low density lipoprotein (LDL-C) cholesterol, along with normal body fat percentage, reduces the risk of cardiovascular disease morbidity and mortality [3-5]. Evidence also suggests that dislipidemia, if coexists with hyperglycemia, risk of cardiovascular diseases increases further [1]. Previous data implicates that postprandial

dysmetabolism i.e. abnormally increased glucose and lipid levels, is predictor of future cardiovascular risk, in non-diabetics subjects also [3]. In patients with type-2 diabetes as well as non-diabetic subjects, lowering levels of cholesterol not only decrease the incidence of cardiovascular disease but it also improves the prognosis of already existing cardiovascular disease [1-3].

The factors which reduce cholesterol and thus improve lipid metabolism are regular physical exercise and diet control [3,4]. Various pharmacologic agents also help in improving lipid profile [3].

Large amount of research is dedicated to assess the effect of physical activity on metabolism, more specifically on lipid and carbohydrate metabolism. A 14 weeks long study on women with resistance training demonstrated the favourable effect on lipid profile and body fat percentage in healthy, sedentary, premenopausal women [4]. The study showed significant decrease in total body fat and cholesterol [4]. A 17 week research on middle aged obese women with increased physical activity and calorie restriction showed a drop of 5% in fat body weight [6]. A study done on Male Wistar rats showed that after 9 weeks, rats trained without load had a beneficial effects on lipid profile, their LDL-C decreased and HDL-C improved, on the other hand rats trained with load had deleterious effect in the form of increasing myocardial oxidative stress [7]. Longitudinal study based on middle aged individuals between 45-64 years confirmed the beneficial effect of physical exercise on HDL-C, LDL-C, TG, with variability in race and gender [8]. Data also suggests that effect of combining aerobic and resistance-type activities is more pronounced on lipid profile, rather than aerobic activities alone [9].

The present study is a longitudinal study, in this we followed up the participants for the period of 9 months and evaluated the effect of exercise training on lipid profile. In lipid profile the parameters measured were total cholesterol (TC), triglycerides (TG) and high-density lipoprotein cholesterol (HDL-C); while low-density lipoprotein cholesterol (LDL-C) and very low-density lipoprotein cholesterol (VLDL-C) were calculated.

## MATERIAL AND METHODS

A longitudinal study; comprising of 40 male students of physical education aged between 18-25 years was carried out. At the beginning i.e. before starting the study work, all participants were given detailed information about the project and every attempt was made to satisfy their queries. Written consent was obtained from every subject.

All the participants were not involved in regular physical exercise previously. They were willing to start regular physical activity and continue it at least for the period of 9 months and follow up of 9 months. Subjects with history of inborn errors of metabolism, those having endocrine disorders, those with diagnosed familial hyperlipidemia were excluded from study.

**Exercise pattern:** All the subjects were doing a regular planned exercise, about 4½ to 5 hours daily, five days a week, 2 to 2½ hours in the morning and 2 to 2½ hours in the evening. The type of exercise was aerobic type with a daily schedule. The general scheme for exercise, in the morning as well as in the evening, was as follows:

· 45 to 60 minutes: Running, jogging, stretching and warm up exercises.

· Next 1 to 1½ hours: Physical training, involving aerobic exercises.

In-between their schedule of training and physical activity, they took short breaks for rest, as per individual requirements.

Registration of subject for the study was followed by the detailed recording of medical history, personal history and family history. Also a detailed exercise history, other than mentioned above, if any, including daily hours, place, schedule and type of exercise and other exercise related activities like participation in other sports were obtained.

At the time of admission these students were not involved in exercise training, at this point of time the measured lipid profile parameters were considered as baseline measurement. Then these students were followed up for the period of 9 months with lipid profile parameters being measured at the interval of 3 months; i.e. at 3 months, 6 months and 9 months after

commencement of exercise training period. Under all strict aseptic precautions, blood sample was collected from each subject after overnight fasting of about 12 hours. Lipid profile parameters measured are, serum total cholesterol, serum triglycerides and serum high density lipoprotein (HDL-C). Serum very low density lipoprotein (VLDL-C) and serum low density lipoprotein (LDL-C) are calculated.

TC and TG were estimated in the semiautomatic analyzer, (Microlab 300) with the help of kits supplied by Merk specialties private limited, Goa, India. HDL- C was estimated in the autoanalyzer (Vitalab selectra-E) with the help of kits manufactured by Merk specialties private limited, Mumbai, India.

VLDL –C was calculated by formula proposed by Friedwald in 1972 [10].

$$\text{Serum VLDL- Cholesterol (mg/dl)} = \frac{\text{Serum TG (mg/dl)}}{5}$$

LDL –cholesterol was calculated by formula:

LDL- C = Total cholesterol – (VLDL-C + HDL-C)

## RESULTS

All the observations were compared by using one way analysis of variance with repeated measures (ANOVA with repeated measures and Tukey's Multiple Comparison post hoc Test) with the help of software Graph Pad Prism.

Table 1 shows the mean serum levels of TC, TG, VLDL-C, HDL-C and LDL-C along with TC/HDL-C ratio with their standard deviation (SD) before commencement exercise training period (Baseline) and 3, 6 and 9 months after its commencement. As it can be seen from the above table, serum levels of TC, TG, LDL-C, VLDL-C and TC/HDL-C decreased while the levels of HDL increased with increase in the duration of exercise training period.

**Table 1:** Comparison of levels of serum lipid profile at Baseline, 3 Months, 6 Months and 9 Months interval after commencement of exercise training period.

| | Baseline | 3 Months | 6 Months | 9 Months | Significance |
|---|---|---|---|---|---|
| TC (mg/dl) | 174.92 ± 9.36 | 168.35 ± 7.38 | 163.62 ± 6.84 | 159.12 ± 6.41 | P<0.0001 |
| TG (mg/dl) | 92.35 ± 6.04 | 87.4 ± 5.67 | 83.45 ± 5.66 | 80.2 ± 5.21 | P<0.0001 |
| LDL-C (mg/dl) | 120.50 ± 10.47 | 112.98 ± 8.33 | 106.76 ± 8.10 | 100.48 ± 7.78 | P<0.0001 |
| VLDL-C (mg/dl) | 18.47 ± 1.20 | 17.48 ± 1.13 | 16.69 ± 1.13 | 16.04 ± 1.04 | P<0.0001 |
| HDL-C (mg/dl) | 35.94 ± 3.248 | 37.88 ± 2.45 | 40.17 ± 2.49 | 42.605 ± 2.35 | P<0.0001 |
| TC/HDL-C | 4.90 ± 0.53 | 4.46 ± 0.37 | 4.09 ± 0.33 | 3.74 ± 0.28 | P<0.0001 |

**Table 2:** Comparison of serum cholesterol levels.

| Tukey's Multiple Comparison Test | Mean Diff. | Significant? P<0.05? | 95% CI of diff |
|---|---|---|---|
| Baseline vs 3 Months | 6.575 | Yes | 5.186 to 7.964 |
| Baseline vs 6 Months | 11.3 | Yes | 9.911 to 12.69 |
| Baseline vs 9 Months | 15.8 | Yes | 14.41 to 17.19 |
| 3 Months vs 6 Months | 4.725 | Yes | 3.336 to 6.114 |
| 3 Months vs 9 Months | 9.225 | Yes | 7.836 to 10.61 |
| 6 Months vs 9 Months | 4.5 | Yes | 3.111 to 5.889 |

**Table 3:** Comparison of serum LDL-C levels.

| Tukey's Multiple Comparison Test | Mean Diff. | Significant? P < 0.05? | 95% CI of diff |
|---|---|---|---|
| Baseline vs 3 Months | 7.525 | Yes | 6.156 to 8.894 |
| Baseline vs 6 Months | 13.74 | Yes | 12.37 to 15.11 |
| Baseline vs 9 Months | 20.03 | Yes | 18.66 to 21.40 |
| 3 Months vs 6 Months | 6.217 | Yes | 4.848 to 7.587 |
| 3 Months vs 9 Months | 12.5 | Yes | 11.13 to 13.87 |
| 6 Months vs 9 Months | 6.285 | Yes | 4.916 to 7.654 |

When TC and LDL-C levels were compared at Baseline, 3 Months, 6 Months and 9 Months interval after commencement of exercise training period, we found that levels of both of these decreased in response to increase in the duration of exercise training period (table 2 and 3). The results were found to be statistically significant.

**Table 4:** Comparison of TC/HDL-C between all the groups.

| Tukey's Multiple Comparison Test | Mean Diff. | Significant? P < 0.05? | 95% CI of diff |
|---|---|---|---|
| Baseline vs 3 Months | 0.4436 | Yes | 0.3695 to 0.5177 |
| Baseline vs 6 Months | 0.8162 | Yes | 0.7420 to 0.8903 |
| Baseline vs 9 Months | 1.159 | Yes | 1.084 to 1.233 |
| 3 Months vs 6 Months | 0.3726 | Yes | 0.2985 to 0.4467 |
| 3 Months vs 9 Months | 0.7149 | Yes | 0.6408 to 0.7891 |
| 6 Months vs 9 Months | 0.3424 | Yes | 0.2682 to 0.4165 |

After comparing the TC/HDL-C ratio at Baseline, 3 Months, 6 Months and 9 Months interval of exercise training period, it was found to be decreased with increase in duration of exercise training period(table 4), the results were found to be statistical significant.

## DISCUSSION

In this follow-up study we found that the parameters of lipid profile started to alter as early as in the first 3 months. These improvements in the lipid profile continued till the last measurement in the study i.e. at 9 months. The important finding of the present study is, decrease in serum levels of TC, TG, and TC/HDL-C ratio. Along with this, a significant improvement in serum level of HDL-C was observed, while reduction is noted in calculated parameters of lipid profile i.e. LDL-C, VLDL-C as the duration of exercise training period progressed.

Considering the public health point of view, our study to see the effect of exercise training on lipid profile is important, as considerable data suggests the association between obesity and chronic diseases like coronary heart diseasesand diabetes mellitus type 2[1-5].

Longitudinal studies done on hypercholesterolemic men, obese women with calorie restriction, menopausal women, healthy, sedentary premenopausal women shows a significant interaction between the exercise training and changes in TC, HDL-C and TC: HDL-C ratio [4,11-13]. Evidence also suggests that only calorie restriction reduces adiposity, but it is less marked as compared to that of combination of calorie restriction with physical exercise.[12] Beneficial effect of regular physical exercise to increase the HDL level and decrease in TC and LDL-C levels is demonstrated by many previous studies in different type of study groups and the findings in our study are consistent with that.

During physical exercise and in post exercise recovery period, oxidation of lipids increases, and reduces adiposity [14]. Physical activity is also believed to increase the activity of lipoprotein lipase which enhances the clearance of TG by using it as a fuel. The same enzyme also increases the conversion of VLDL-C to HDL-C [15]. Regular physical exercise is also believed to decrease insulin resistance and improve lipid and carbohydrate metabolism [15].

The correlation of obesity with inflammation and immunity is understudied; the available data suggests that rate of infections of several organs and systems is higher in obese population as compared to normal weight individuals [16]. Increased adiposity also plays a role in increasing inflammation by increasing the production and release of variety of proinflammatory and anti-inflammatory factors, including adipokines, leptin and adiponectin, as well as cytokines and chemokines [16]. But there is not enough evidence available to establish the correlation between obesity and infection, more research is required for the same.

The strength of this study is regular follow up of participants for 9 months and comparing selected parameters at every 3 months. This gave us an idea about alteration in readings at every 3 months. Almost all the parameters showed a positive change at every reading, demonstrating that, apart from regularity, duration also plays important role in benefits of physical activity.

## CONCLUSION

Finding in our study suggest that, regular physical exercise has possible effect on improving lipid metabolism indicated by a positive change in lipid profile with increase in duration of exercise training period. The improvement noted in lipid profile parameters is, decrease in serum levels of TC, TG, and TC/ HDL-C ratio while increase in serum levels of HDL-C were observed, significant reduction is also seen in calculated parameters i.e. LDL-C, VLDL-C, as the duration of exercise training period progressed. Regular physical activity may be associated with decreased risk of chronic diseases like diabetes mellitus type 2, coronary heart disease.

These positive effects of regular physical exercise on lipid profile parameters remain or revert back completely or partially to their previous levels after stopping the exercise or after a significant gap are not well defined. Further studies are required to explore the same.

### ABBREVIATIONS:

**ANOVA:** Analysis Of Variance
**HDL-C:** High Density Lipoprotein Cholesterol
**i.e.:** That is
**LDL-C:** Low Density Lipoprotein Cholesterol
**TC/HDL-C ratio:** Total Cholesterol/ High Density Lipoprotein Cholesterol Ratio
**TC:** Total Cholesterol
**TG:** Triglyceride
**VLDL-C:** Very Low density lipoprotein Cholesterol

**Conflicts of interest:** None

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