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# HDL AND PHYSICAL FITNESS – DO THEY GO HAND IN HAND?

## Evaluation of Lipid Levels and Physical Fitness in Euthyroid and Hypothyroid States (III Prize Winning Article - Vin-Bio-Celesta 2012 - All India Dissertation Competition)

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**ABSTRACT**

**Background and objectives**: Thyroid hormones influence all aspects of lipid metabolism including synthesis, mobilization, and degradation. Non-exercise test models for estimating the cardiorespiratory fitness could be used as a simple, reliable and cost effective method of estimating physical fitness in healthcare settings. The present study was performed to evaluate the effect of hypothyroidism on lipid levels and physical fitness and to find the correlation between physical fitness and HDL levels. **Materials and Methods:** This was a hospital based case control study which included 50 healthy euthyroid subjects of 30-60 years of age and 36 hypothyroid subjects of 30-60 years of age. Physical activity was assessed by validated international physical activity questionnaire (IPAQ). Estimation of VO2 Max (cardiorespiratory fitness) was done using the Non exercise regression model developed by Jackson. **Results:** In the hypothyroid group, physical fitness is negatively correlated with TC and LDL and physical activity is found to be negatively correlated with TC, TGL, LDL and VLDL. In the control group, physical activity and physical fitness shows a negative correlation with TC and LDL levels. **Conclusion** Our results suggest that physical fitness is found to be more related to total cholesterol and LDL levels rather than HDL levels in both the cases and the control group.

**Keywords**: HDL, Physical fitness, VO2max, IPAQ, cardio respiratory fitness.

### INTRODUCTION

Physical fitness is an integrated measure of most of the body functions (skeletomuscular, cardio respiratory, hemato circulatory, psychoneurological and endocrine–metabolic) involved in the performance of daily physical activity and/or physical exercise.[1] Although physical fitness is an important health indicator, fitness assessment is usually not performed in many healthcare settings as it is influenced by the feasibility and cost of measuring the parameter.

Non–exercise test models estimate physical fitness from the regression of measured maximal oxygen uptake (VO2max) on independent variables known to be predictive of physical fitness, such as gender, age, body size, resting heart rate(HR), and self reported habitual physical activity levels. This method avoids the burden of exercise testing, while providing a reasonably accurate estimation of Physical fitness.[2, 3, 4] Hence nonexercise test models for estimating the physical fitness would be a simple reliable and cost effective method.

Thyroid dysfunction is one of the most common endocrinological disorder. Thyroid gland synthesizes hormones which has a significant role in control of basal metabolic rate, general body metabolism, growth and tissue differentiation. Lipid abnormalities are reported to be more common in patients with hypothyroidism.[5] In hypothyroidism reduced catabolism of lipoproteins and decreased expression of LDL receptor in liver results in elevated serum cholesterol and LDL levels.[6] Also reduced lipoprotein lipase activity and decreased hepatic lipase activity results in high levels of triglycerides.[7,8] The present study was performed to evaluate the effect of hypothyroidism on lipid levels and physical fitness and to find the correlation between physical fitness and HDL levels.

### AIMS AND OBJECTIVES

1. Evaluation of lipid levels, physical fitness in patients with hypothyroidism and comparing it with normal healthy controls.
2. To find correlation among physical activity, physical fitness and lipid levels in hypothyroid and euthyroid subjects.

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## MATERIALS AND METHODS

This was a hospital based case control study and was conducted in the Department of Biochemistry at Sri Manakula Vinayagar Medical College and Hospital, Pondicherry. Informed consent was obtained from both the cases and the controls.

Sample size:

50 normal healthy euthyroid subjects of 30-60years of age.

36 hypothyroid subjects of 30-60 years of age.

**Study setting:**

A representative sample of local population comprising of 86 subjects aged 30-60 years are selected from

1. Hypothyroid patients attending medicine OPD in SMVMCH.
2. Normal healthy euthyroid subjects are attendants of patients, workers in SMVMCH.

**Inclusion criteria**

Cases: The patients who were diagnosed hypothyroid in the outpatient and inpatient ward of Department of Medicine based on the thyroid and clinical profile.

Controls: subjects with normal thyroid status.

**Exclusion criteria**

Patients with any cardiovascular disease, respiratory disorder, hypertension, diabetes mellitus or physically challenged persons were excluded.

**Sample collection**

3ml of whole blood was collected from the cases and the controls after overnight fasting with dry disposable syringe and needle by venepuncture under all aseptic precautions. Then serum was separated after subjecting the collected blood to centrifugation at 2500 rpm for 5min. Serum was divided into two aliquots. One aliquot was used for thyroid function tests (TSH, Free T3, Free T4) and the another immediately used for analysis of total cholesterol (TC), high density lipoprotein (HDL) and triglycerides (TG).

**Estimation of Thyroid function**

1. Serum freeT3 (normal range 1.4-4.2 pg/dl) was measured by competitive analogue immunoassay method using standard kits obtained from Siemens Healthcare Diagnostics Ltd on a Immulite fully automated analyzer (Siemens).
2. Serum freeT4 (0.8-2.0ng/dl) was measured by solid phase enzyme labeled chemiluminescent competitive immunoassay method.
3. Serum TSH (0.3-6.1mIu/ml) was measured by solid phase two site chemiluminescent immunometric assay method.

**Estimation of Serum Lipids**

1. Serum total cholesterol (normal range 150-220mg/dl) (TC) was measured by cholesterol oxidase – peroxidase method.
2. Triacylglycerol (normal range50-160mg/dl) (TG) levels by glycerol kinase – peroxidase method.
3. HDL cholesterol (normal range 35-60 mg/dl) (HDL) by divalent cation precipitation method. All these methods was analyzed using reagent kits supplied by AGAPPE diagnostics, kerala, India, in Cobas Miras Plus Automated Chemistry Analyzer (USA).
4. LDL cholesterol (LDL) and VLDL were calculated by Friedwald's formula [LDL=TC − (VLDL+HDL)] , [VLDL=TG/5]. [12]

**Assessment of physical fitness:**

**Body composition**

Body mass was measured to the nearest 0.1 kg, with the participants dressed in light clothing. Barefoot standing height was measured to the nearest 0.1 cm with a wall-mounted stadiometer. Body mass index (BMI) is used for the assessment of fat distribution and obesity. Using standard measures of height and weight, BMI was measured using Quetelet's index (BMI = weight (kilograms)/height (metre$^2$). [13]

**Waist – hip ratio (WHR)**

The ratio of the waist and hip (WHR) was calculated after determining the waist (WC) and hip (HC) circumferences at the umbilicus height and at the greatest circumference in the pelvic bone, respectively. [13]

**Assessment of physical activity (PA)**

PA was assessed by validated international physical activity questionnaire (IPAQ) form, where PA was

measured as metabolic equivalent (MET) minutes per week. Based on the response to the IPAQ form, MET was calculated and the subjects were classified as low (<600 MET-min/week), moderate (601-1500 MET-min/week), and high (>1501 MET-min/week) and were assigned the values of 1, 2, 3 levels respectively. These values were then used in the non exercise regression equation to estimate VO2 max.[11]

**Physical fitness /Cardio Respiratory Fitness (CRF)**

Maximal oxygen consumption (VO2 max) is the ability to uptake, transport and use oxygen and also a strong indicator of Physical fitness. It is estimated by Estimation of VO2 Max Using the Non exercise Regression Model. The regression model, originally developed by Jackson, was used to estimate CRF according to

VO2 max = [Gender (female = 0; male = 1) * 2.77] – [Age *0.10]– [BMI * 0.17] – [resting HR * 0.03] + [PA level * 1]+ 18.07. [11]

**Statistical analysis**

The results were expressed as mean ± standard deviation. The data analysis was carried out using SPSS for windows 11.5 software. Comparison of parameters between hypothyroid subjects and normal healthy controls was done with student't' test. Pearson's correlation was applied to test for association between continuous variables. A p-value <0.05 was considered statistically significant.

**RESULTS**

The results are presented as mean ± standard deviation in table 1. Table 1 shows the comparison of thyroid hormones and lipid profile among the cases and controls. No significant difference was seen in the lipid profile among the cases and the controls.

In Figure 1, no significant difference was seen among the cases and controls in relation to age, physical activity and physical fitness (VO2 max).

Table 2 shows negative correlation of physical fitness with TC and LDL among the hypothyroid cases. Physical activity is found to be negatively correlated with TC, LDL, TGL and VLDL among the hypothyroid cases.

Table 3 shows negative correlation of Physical fitness with TC and LDL among the control group. Physical activity is found to be negatively correlated with TC and LDL among the control group.

Table 4 shows relationship of thyroid hormones to physical fitness and physical activity among the cases. No statistically significant correlation was seen between physical fitness and physical activity with thyroid hormones.

**TABLE 1 - Comparison of various parameters between the hypothyroid and normal euthyroid group**

| Parameters | CASES(n=36) | CONTROLS(n=50) |
|---|---|---|
| FT3 (pg/dl) | 1.33 ± 0.40 | 2.75 ±0.45 |
| FT4 (ng/dl) | 0.52 ± 0.26 | 0.98 ±0.18 |
| TSH (mIU/ml) | 30.40 ± 23.32 | 1.67 ±0.77 |
| TC (mg/dl) | 228.77 ± 49.25 | 209.4 ±43.7 |
| TGL (mg/dl) | 178.30 ± 84.60 | 152.86 ±71.88 |
| LDL (mg/dl) | 158.22 ± 43.8 | 141.1± 45.16 |
| HDL (mg/dl) | 35.69 ± 4.99 | 37.4 ± 5.59 |
| VLDL (mg/dl) | 35.41 ±16.21 | 31.62± 15.57 |

Data are presented as Mean ±SD. TC=Total cholesterol, TGL=Triglycerides, LDL=Low density lipoprotein, HDL= High density lipoprotein, VLDL=Very low density lipoprotein.

**Table 2-Correlation of VO2max and Physical activity with lipid profile among the cases**

| Parameters (cases, n=36) | Physical fitness(VO2max) | | Physical activity | |
|---|---|---|---|---|
| | R value | P value | R value | P value |
| TC | -0.461 | 0.005* | -0.454 | 0.005* |
| TGL | -0.328 | 0.051 | -0.358 | 0.032* |
| LDL | -0.401 | 0.015* | -0.385 | 0.021* |
| HDL | 0.163 | 0.343 | 0.154 | 0.370 |
| VLDL | -0.355 | 0.033 | -0.345 | 0.040* |

Pearson correlation analysis was performed to analyze the data. * p<0.05 is considered statistically significant. TC=Total cholesterol, TGL=Triglycerides, LDL=Low density lipoprotein, HDL= High density lipoprotein, VLDL=Very low density lipoprotein.

**Table 3-Correlation of VO2max and Physical activity with lipid profile among the controls**

| Parameters (controls ,n=50) | Physical fitness(VO2max) | | Physical activity | |
|---|---|---|---|---|
| | R value | P value | R value | P value |
| TC | -0.502 | 0.000* | -0.576 | 0.000* |
| TGL | -0 .09 | 0.492 | -0.190 | 0.187 |
| LDL | -0.476 | 0.000* | -0.516 | 0.000* |
| HDL | 0.138 | 0.339 | 0.034 | 0.817 |
| VLDL | -0.34 | 0.816 | -0.107 | 0.458 |

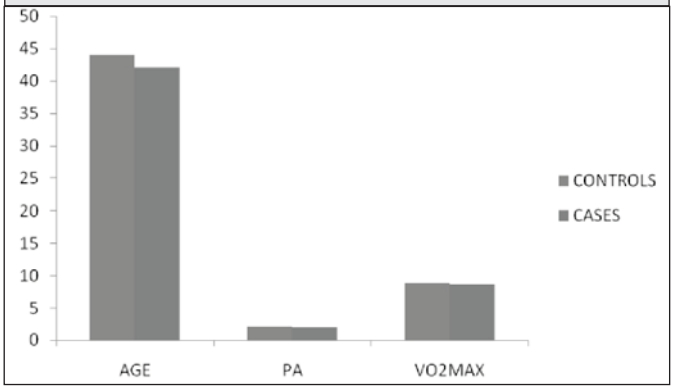
Pearson correlation analysis was performed to analyze the data. * p<0.05 is considered statistically significant. TC=Total cholesterol, TGL=Triglycerides, LDL=Low density lipoprotein, HDL= High density lipoprotein, VLDL=Very low density lipoprotein.

**Table 4-Correlation of VO2max and Physical activity with thyroid profile among the cases**

| Parameters (controls, n=50) | Physical fitness(VO2max) | | Physical activity | |
|---|---|---|---|---|
| | R value | P value | R value | P value |
| FT3 | 0.043 | 0.803 | 0.020 | 0.910 |
| FT4 | 0.104 | 0.547 | 0.069 | 0.690 |
| TSH | -0.042 | 0.809 | -0.150 | 0.382 |

Pearson correlation analysis was performed to analyze the data.

**Figure1- Comparison of Age, Physical activity (PA) and VO2max between the cases and controls**




## DISCUSSION

This study relates the physical fitness and lipid profile in normal healthy subjects and in hypothyroidism. Thyroid hormones influence both synthesis and degradation of lipids. In hypothyroidism reduced catabolism of lipoproteins and decreased number of LDL receptors in liver results in elevated serum cholesterol and LDL levels.

Our results show no significant difference in the lipid profile among the hypothyroid cases and the controls. This supports the findings of Kuldip S et al which showed no statistically significant difference in serum cholesterol, LDL and HDL levels in hypothyroid patients as compared to healthy euthyroid controls. Similarly, physical activity and physical fitness did not show difference among cases and controls.[14]

In the hypothyroid group, physical fitness is negatively correlated with TC and LDL. Physical activity is found to be negatively correlated with TC, TGL, LDL and VLDL (Table 2). In other metabolic disorders like diabetes VO2max correlated inversely with TC, LDL and TG but not with HDL or VLDL. Austin et al found negative correlation between VO2max and TC and LDL cholesterol in diabetic patients. [15]

In the control group, physical activity and physical fitness shows a negative correlation with TC and LDL levels (Table 3). This supports the findings of Hiroyuki et al which showed a significant correlation between physical activity and physical fitness with TC.[16]

Table 4 shows a negative correlation of TSH with VO2 max among the cases but is not found to be statistically significant. Constantinos et al showed a positive correlation of VO2max with T3 but no significant correlation with T4 or TSH .[17]To our present knowledge there are no studies relating physical fitness and hypothyroidism.

Our results suggests that physical fitness is found to be more related to total cholesterol and LDL levels rather than HDL levels in both the cases and the control group. Triglycerides and VLDL are found to be related to physical activity alone both in the cases and the controls. Thyroid hormone disorders like hypothyroidism did not interrupt the relationship of physical activity and physical fitness with total cholesterol and LDL. So, irrespective of thyroid hormone status physical activity and physical fitness are related with lipid levels in this age group.

Hence, total cholesterol and LDL can be used as an indicator of physical fitness. A large scale study is warranted to further validate the findings of the present study.

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