Research Article

# A study of correlation of serum lipid profile in patients with hypothyroidism

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**Abstract**

**Background:** Hypothyroidism is a common problem that reduces the functional ability of life. Hypothyroidism is associated with altered lipid levels, which increases the cardiovascular risk.

**Objective:** The objectives of this study were to study whether there is any correlation between serum lipid levels and hypothyroidism (subclinical and overt) in a rural population of Gujarat and to study whether there is any difference in lipid levels among menopausal and postmenopausal women.

**Materials and Method:** A cross-sectional study was conducted at Clinical Biochemistry department, P.S. Medical College, Karamsad, which consisted 100 hypothyroid patients (subclinical and overt) and 100 similar age- and sex-matched controls. Serum total thyroxine, triiodothyronine, thyroid-stimulating hormone, free thyroxine, serum cholesterol, triglyceride, high-density lipoprotein (HDL) and low-density lipoprotein levels were examined in subclinical and euthyroid patients.

**Results:** In patient with subclinical hypothyroidism, we found elevated serum total cholesterol (217.95) and triglyceride (148.35) levels as compared to controls ($P = 0.001$) but statistically insignificant HDL level (51.45; $P = 0.973$). In patient with overt hypothyroidism, elevated serum total cholesterol (271.92) and triglyceride (166.31) were found as compared to control ($P = 0.001$), but HDL level (46.57; $P = 0.134$) was found to be decreased.

**Conclusion:** There is association between subclinical and overt hypothyroidism with dyslipidemia. This might be a potential risk factor for coronary artery disease.

**KEY WORDS:** Hypothyroidism, lipid profile, TSH

## Introduction

Hypothyroidism is a common problem; it causes symptoms that reduce the functional status and quality of life. Hypothyroidism is defined as a deficiency of thyroid activity. It results from reduced secretion of either total thyroxine (T4) or triiodothyronine (T3). It leads to hypersecretion of pituitary thyroid-stimulating hormone (TSH) and so greater increase in serum TSH levels.

Subclinical hypothyroidism can be defined as a high serum TSH concentration and normal serum total or free T4 and T3 concentrations associated with a few or no symptoms and signs of hypothyroidism.[1] It is referred to as a state of mild thyroid failure.[2] Subclinical hypothyroidism is more common in the elderly and is found twice in women as in men.[3] It is a more common disorder than overt hypothyroidism[4] and hence early diagnosis and treatment may prevent the onset of overt hypothyroidism along with its associated effects.

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As thyroid failure progresses, serum free T4 levels fall, and the combination of elevated TSH and low free T4 concentrations is termed as overt hypothyroidism. Serum total and free T3 levels may not fall until disease is far advanced, because increased TSH levels stimulate T3 release from the thyroid. When patients develop overt hypothyroidism, they show classic symptoms and signs of hypothyroidism such as fatigue, weight gain, cold intolerance, constipation, dry skin, hoarseness, mental impairment, depression, decreased appetite, and arthralgias.

Hypothyroidism may be associated with increased risk of coronary artery disease, peripheral vascular disease, and various biochemical abnormalities, including increased low-density lipoprotein-cholesterol (LDL-C) levels and increased total cholesterol and serum triglyceride (TG) values.[5]

## Materials and Method

The study was conducted at Clinical Biochemistry department, Shree Krishna Hospital, Pramukh Swami Medical College, Karamsad, which is a tertiary-care rural center. It was a cross-sectional study carried out over a period of 1 year.

Control group consisted of 100 similar age and sex persons taken from a population coming for whole-body health checkup scheme. Case group consisted of 100 patients with hypothyroidism (subclinical and overt). This group subjects were selected from patient population coming to Medicine and ENT OPD for the routine checkup. Confounding variables were removed.

Fasting blood samples were taken in a plain gel vaccutainer tube with an aseptic blood collection technique. The samples were centrifuged within 1 h at 3000 rpm for 5 min. These were processed to obtain serum for the estimation of serum lipid profile and thyroid hormone level. Estimation of fasting lipid profile (TG, cholesterol, and HDL) was carried out on a fully automated Cobas Integra 400 plus clinical chemistry analyzer. LDL value was derived by Friedwald's formula: {LDL = Total Cholesterol – [HDL + (Triglyceride/5)]}. And thyroid function test was estimated with electrochemiluminescence method on Elecsys 2010. T3, T4, and FT4 levels were estimated by competitive principle and TSH by sandwich principle.

Student's *t*-test was used to find out the significance of study parameters between cases and controls. Analysis of variance (ANOVA) was used to study the influence of a qualitative factor on another variable with a normal distribution. Before applying ANOVA, Levene's test for equality of variances was used. If Levene's test was found to be positive, then the variances in the different groups were different. In ANOVA, if the *P*-value was less than 0.05, then we accepted the hypothesis that there is an influence of the qualitative factor on the dependent data. After the ANOVA, Student–Newman–Keuls test (*post hoc* test) was performed for pairwise comparison of subgroup.

**Table 1:** Level of thyroid and lipid profile in cases and controls

| Lipid parameters | Controls | Cases | *P*-value |
|---|---|---|---|
| Age in years (mean) | 52.23 | 46.44 | 0.488 |
| Sex | 93% Female<br>7% Male | 89% Female<br>11% Male | – |
| T3 (ng/dl) | 123.85±17.92 | 102.20±25.38 | 0.001 |
| T4 (µg/dl) | 8.25±1.44 | 6.08±2.44 | <0.001 |
| TSH (µIU/ml) | 2.52±0.895 | 32.83±36.24 | <0.001 |
| FT4 (ng/dl) | 1.05±0.08 | 0.91±0.173 | <0.001 |
| Total cholesterol (mg/dl) | 164.27±18.43 | 241.96±32.24 | <0.001 |
| Triglycerides (mg/dl) | 96.80±32.07 | 155.18±39.22 | 0.075 |
| HDL (mg/dl) | 51.01±13.03 | 49.5±11.25 | 0.146 |
| LDL (mg/dl) | 93.87±19.93 | 157.71±30.60 | <0.001 |
| VLDL (mg/dl) | 19.15±6.55 | 31.21±8.28 | 0.021 |

HDL, high-density lipoprotein; TSH, thyroid-stimulating hormone; LDL, low-density lipoprotein; VLDL, very low density lipoprotein

## Results

In this study, the mean age of patients with hypothyroidism was 52.23 years and that of controls was 46.44 years ($P$ = 0.488). The 89% of cases and 93% of controls were female; 11% of cases were male as compared to 7% of controls. So, overall this study population shows a female predominance [Table 1].

The mean T3 level in the cases was 102.20 ng/dl and that in the control was 123.85 ng/dl, which was statistically significant with a *P*-value of 0.001. Mean T4 level in cases was 6.08 µg/dl and that in controls was 8.25 µg/dl ($P$<0.001). Mean TSH level in cases with hypothyroidism was 32.83 µIU/ml and that in euthyroid controls was 2.52 µIU/ml. This was found to be statistically significant with *P*-value <0.001. Mean FT4 level in cases was 0.91 ng/dl and that in controls was 1.05 ng/dl ($P$ < 0.001). The mean total cholesterol level in cases was 241.96mg/dl and that in controls was 164.27 mg/dl ($P$< 0.001). The mean serum TG value in cases with hypothyroidism was 155.18 mg/dl whereas that in euthyroid controls was 95.79 mg/dl. This difference was not statistically significant ($P$ = 0.075). Patients with hypothyroidism had a mean high-density lipoprotein (HDL) value of 49.6 mg/dl and euthyroid controls had 50.1 mg/dl. However, this was not found to be statistically significant ($P$ 0.146). Cases had a mean LDL-C value of 157.71 mg/dl whereas controls had a mean LDL value of 93.87 mg/dl ($P$ < 0.001). The mean very low density lipoprotein (VLDL)-cholesterol value in cases was 31.21 mg/dl and that in controls was 19.15 mg/dl ($P$ = 0.021).

### Menopausal status

In Table 2, of the total 89 females, 30 are in menopausal stage and 59 patients were in postmenopausal stage.

The lipid levels in menopausal and postmenopausal patients were found to be statistically insignificant. Similarly, thyroid hormone difference between menopausal and

**Table 2:** Distribution of lipid profile and thyroid hormone as per menopausal status

| Tests | Menopausal | Post- menopausal | *P*-value |
|---|---|---|---|
| T3 | 93.39±26.26 | 108.41±22.21 | 0.276 |
| T4 | 5.39±2.64 | 6.61±2.16 | 0.199 |
| TSH | 47.61±40.91 | 24.08±30.27 | 0.055 |
| Total cholesterol | 252.73±28.61 | 235.94±34.47 | 0.276 |
| Triglyceride | 155.33±34.33 | 154.35±40.24 | 0.354 |
| HDL | 45.9±9.89 | 51.93±11.56 | 0.363 |

HDL, high-density lipoprotein; TSH, thyroid-stimulating hormone

postmenopausal groups was also found to be statistically insignificant. So prevalence of any thyroid abnormality was independent of the menopausal status.

**Association between lipid levels and thyroid status**

To study the correlation between the hypothyroidism and lipid levels, the patients were further divided into three groups [subclinical (A), overt (B), control(C)]. In this study group, 62 patients were found to be with subclinical hypothyroidism and 38 patients with overt hypothyroidism on the basis of T3, T4, free T4, and TSH levels in serum.

It is clear from Table 3 that mean level of total cholesterol in subclinical hypothyroidism is 217.95 mg/dl, that in overt hypothyroidism is 271.92 mg/dl, and that in control is 164.27 mg/dl. When group A was compared with group C, the former had higher total cholesterol levels, which were statistically significant ($P$ = 0.001). When group B was compared to group C, the former had higher total cholesterol levels, which were statistically significant ($P$ = 0.003). When groups A and B were compared, a statistically significant difference was found ($P$ = 0.001).

Mean level of TG in subclinical hypothyroidism was 148.35 mg/dl, that in overt hypothyroidism was 166.31 mg/dl, and that in control was 95.79 mg/dl. When group A was compared to group C, the former had higher level of TG, which was statistically significant with the *P*-value of 0.001. When group B was compared to group C, the former had higher level of TGs, which was statistically significant with the *P*-value of 0.001. When groups A and B were compared, a statistically insignificant difference was found ($P$ = 0.071).

Mean level of HDL in subclinical hypothyroidism was 51.45 mg/dl, that in overt hypothyroidism was 46.57 mg/dl, and that in control was 51.01 mg/dl. When group A was compared with group C, both of them were found to have similar value, which was statistically insignificant with the *P*-value 0.973. When group B was compared with group C, the former had lower value than group C, which was statistically insignificant with the *P*-value of 0.134. When groups A and B were compared, a statistically insignificant difference was found ($P$ = 0.126).

Mean level of LDL in subclinical hypothyroidism was 142.69 mg/dl, that in overt hypothyroidism was 182.23 mg/dl, and that in control was 93.87 mg/dl. When group A was compared with group C, the former had higher value, which was statistically insignificant ($P$ = 0.001). When group B was compared with group C, the former had higher value, which was statistically significant ($P$ = 0.001). When groups A and B were compared, a statistically significant difference was found ($P$ = 0.07).

## Discussion

In this study, the mean age of patients was 52.23 years and higher number of cases were seen in individuals in 50–60 years age group. This was similar to that reported in a study by Luboshitzky et al.[6] in which it was found to be 50.85 years. The present study showed female predominance with 89% versus male 11% of total cases. This is again similar to that shown in a study by Bhandopadhyay et al.,[7] who observed that females constituted 78% of study population. Many major studies have been done only on women. Thyroid disease is much more prevalent in women than men; women are 5–8 times more likely to develop hypothyroidism.

This study revealed that the thyroid function abnormality and lipid levels in the menopausal and postmenopausal groups were statistically insignificant. This was similar to that reported by Shilbayeh[8] in which the total prevalence of thyropathy was found to be 29.5% of the study population. There was no marked association found between thyropathy of either menopausal status ($P$ = 0.3) or dyslipidemia ($P$ = 0.56).

The study by Usoro et al.,[9] aimed to determine the influence of menopause on lipid profile in women. The total cholesterol and LDL-C values were significantly ($P$ < 0.05) higher and HDL-C value was 1.24±0.43 lower than those seen in the premenopausal women. No statistically significant differences

Table 3: Association between lipid levels and thyroid status

| | Subclinical hypothyroidism (A) | Overt hypothyroidism (B) | Control(C) | *P*-value (A) & (C) | *P*-value (B) & (C) | *P*-value (A) & (B) |
|---|---|---|---|---|---|---|
| TC | 217.95 | 271.92 | 164.27 | **0.001** | **0.003** | **0.001** |
| TG | 148.35 | 166.31 | 95.79 | **0.001** | **0.001** | 0.061 |
| HDL | 51.45 | 46.57 | 51.01 | 0.973 | 0.134 | 0.126 |
| LDL | 142.69 | 182.23 | 93.87 | **0.001** | **0.001** | 0.07 |

TC, total cholesterol; TG, triglycerides; HDL, high-density lipoprotein; LDL, low-density lipoprotein

($P > 0.05$) were observed in both TG and VLDL-C levels in both the postmenopausal and premenopausal women.

In our study, the hypothyroid cases had a mean total T3 value of 102.20 ng/dl and mean total T4 value among hypothyroid cases was 6.08 µg/dl. This was statistically significant ($P < 0.001$). Total T4 levels in cases were toward the lower limit of normal, indicating that there is a trend toward impending thyroid failure if not intervened immediately.

In the present study, mean TSH values in hypothyroid cases was 32.83 µIU/ml. The standard deviation was high because of the wide range of results of the TSH. This was similar to that reported by Singh et al.[10] who demonstrated TSH value of 45.08 µIU/ml. In Prakash and Lal [11], study the authors divided the hypothyroid patient in to the two groups according to the TSH value. Group 2 had TSH value 33 µIU/ml, which is similar to that reported by us.

In our study, the mean FT4 value in hypothyroid cases was 0.63 ng/dl, which was statistically significant ($P = 0.001$) between hypothyroid cases and control group. This was similar to that reported in a study by Singh et al.[10] in which mean FT4 value was found to be 0.67 ng/dl. Luboshitzky et al.[6] reported FT4 value to be 7.2 pmol/l, which was statistically significant. Velkoska Nakova et al.[12] showed FT4 value to be 0.006 pmol/l, which was insignificant. This is different than the current study.

In this study, mean total cholesterol level in cases with hypothyroidism was 241.96 mg/dl ($P < 0.001$). Efstathiadou et al.[13] found a mean total cholesterol value of 222 mg/dl. Hueston and Pearson[4] showed a total cholesterol level of 217 mg/dl. However, many other studies have reported higher mean total cholesterol values as compared to this study.

In the current study, hypothyroid cases had a mean serum TG value of 155.18 mg/dl ($P < 0.001$). Kong et al.[14] had reported mean value of 159 mg/dl. Hueston and Pearson[4] had shown mean TG value of 178.1 mg/dl in their study.

In this study, mean HDL-C levels were 49.6 mg/dl in hypothyroid cases, which is similar to those found in the control group. Rajan et al.[15] showed a HDL value of 41.5 mg/dl, which was not statistically significant. Some studies in the West have shown variable HDL responses.

In this study, cases with hypothyroidism had a mean LDL-cholesterol value of 157.71 mg/dl with a statistically significance P value of <0.001 compared to control group. However, many Western studies have shown statistically and clinically significant LDL-cholesterol values. Tromsø study[16] also showed elevated LDL-cholesterol levels, which came down after treatment.

In our study, 62% of cases had subclinical hypothyroidism and 38% of cases had overt hypothyroidism. In patients with overt hypothyroidism and total cholesterol level (271.92), triglyceride (166.31) and LDL (182.23) levels were significantly raised and HDL level (46.57) was lower as compared to control. In patients with subclinical hypothyroidism, total cholesterol (217.95), triglyceride (148.35), LDL (142.69) levels were higher and HDL level (51.45) was same as the control.

In the study by Singh et al.[10], total cholesterol (219.3±50.1), TG (242.6±52.5), LDL (126.2±40.9) values were significantly raised in patients with overt hypothyroidism as compared to control group whereas HDL level (31.3±7.6) was found to be significantly lower. TG (93.2±91.19) and LDL (106.2±33.97) values showed significantly higher levels in subclinical hypothyroidism group as compared to control group. This was similar to that found in our study in which in overt hypothyroidism TC, TG, LDL values were raised and HDL value was found to be decreased. In patients with subclinical hypothyroidism, only TG and LDL values were found to be raised.

In Gupta and Sinha[17] study, mean serum cholesterol level was significantly raised in patients with both subclinical ($P < 0.05$) and overt hypothyroidism ($P < 0.005$) with respect to control group. In patients with overt hypothyroidism, mean serum TG ($P < 0.05$) and LDL ($P < 0.05$) levels were significantly higher compared to control group. This was partially similar to our study; only difference is in the TG level, which is insignificant.

Rajan et al.[15] studied the lipid profile in patients with subclinical and overt hypothyroidism. TG, total cholesterol, LDL cholesterol, total cholesterol/HDL ratio, LDL/HDL ratio were higher in patients with both overt and subclinical hypothyroidism whereas HDL showed variable response. This result was similar to that of our study.

Canaris et al.[18] in their study determined the relationship between abnormal thyroid function and lipid levels. A higher proportion of hypothyroid subjects had elevated serum levels of TC ($P = 001$) and LDL cholesterol ($P = 001$) compared with the euthyroid group. Serum TG and HDL cholesterol levels did not change significantly. Lipid levels increased in a graded manner as thyroid function declined. This result was partially similar to the result of our study.

Madani et al.[19] showed a significant increase ($P < 0.001$) in the levels of TC (237.50±1.01 mg/dl), TG (168.53± 0.89), and LDL-C levels (166.25±1.03) in patients with subclinical hypothyroidism when compared with the controls. No differences in the levels of HDL-C were observed among the study groups. This is similar to that found in our study.

In Mansorian AR et al.[20] reported that patients with subclinical hypothyroidism had higher total cholesterol and LDL levels as compared to controls ($P < 0.05$). No significant changes were observed in TG and HDL values. This result was partially similar to that of our study except in TG level, which was insignificant.

Luboshitzky et al.[6] studied serum mean levels of total cholesterol, LDL-C, HDL-C, TGs as well as the TC/HDL-C and LDL-C/HDL-C ratios, the values of which were not significantly different from those in controls. Individual analysis revealed that the percentage of patients with subclinical hypothyroidism having hypertriglyceridemia, hypercholesterolemia, and elevated TC/HDL-C and LDL-C/HDL-C ratios was higher than that of controls.

Hueston and Pearson[4] showed that subclinical hypothyroidism does not appear to be associated with abnormalities in serum cholesterol or TG levels when adjusted for confounding

variables in this population-based study. This finding was different to that of our study.

In a cross-sectional study of 7000 thyroid clinic outpatients, Vierhapper et al.[21] concluded that there were no significant differences in serum total cholesterol, LDL cholesterol, HDL cholesterol, or TG levels between patients with subclinical hypothyroidism and the euthyroid control group.

## Conclusion

It can be concluded that hypothyroidism is more common in the elderly female patients. There was no marked association in menopausal status between thyropathy and lipid levels. In patient with subclinical hypothyroidism, serum levels of total cholesterol and TG were elevated, which were significantly different from those in euthyroid patient. However HDL-C value was normal. In patient with overt hypothyroidism, serum levels of total cholesterol and TG were elevated but HDL level was found to be decreased. These associations between lipid level and thyroid status were comparable to those reported in similarly designed Indian and Western studies. On the basis of findings of this study, we can detect subclinical hypothyroidism "which otherwise does not show clinical symptoms and signs" but biochemical changes occur, so helping us to formulate treatment modality. As we were also able to find out the increased cholesterol level due to either subclinical hypothyroidism or other dyslipidemias, so we can prevent the risk of coronary artery disease.

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