International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 8, August 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.8.2024.92

**ORIGINAL RESEARCH**

# To study association of Lipid abnormalities in hyperthyroidism patients of Kashmir: A hospital based case control study

[1]Suhail Ahmad, [2]Mahpara Nyiem, [3]Mohammad Hayat Bhat, [4]Wasif Kawsar Qadri, [5]Shayees Arawa, [6]Maha Muzaffar, [7]Naira Taban, [8]Anam Shameem Hakak, [9]Nigha Nazir

[1,2,5,6,7,8]Post Graduate Department of Physiology, Govt Medical College Srinagar Kashmir, India
[3]Department of Endocrinology, Super Specialty Hospital, Govt Medical College Srinagar Kashmir, India
[4]Post Graduate Department of Orthopedics, Govt Medical College Srinagar Kashmir, India
[9]Post Graduate Department of Psychiatry, Govt Medical College Srinagar Kashmir, India

**Corresponding Author**
Mahpara Nyiem
Post Graduate Department of Physiology, Govt Medical College Srinagar Kashmir, India
**Email:** peermahpara@gmail.com

Received Date: 14 July, 2024 Acceptance Date: 16 August, 2024

## ABSTRACT

**Background:** Thyroid dysfunction are the most prevalent endocrine problems in the globe. Thyroid hormones are essential for controlling lipid synthesis, metabolism, and mobilization. Circulating lipid levels may change when there is thyroid disease. However, hyperthyroidism are rarely investigated and related to the lipid abnormalities i.e dyslipedmia in Kashmiri Patients. **Aims and Objectives:** In this study an attempt is made to study lipid abnormalities in hyperthyroidism Patients. **Materials and methods:** This study was carried out at Post Graduate Department of Physiology in collaboration with Department of Endocrinology, Government Medical College Srinagar. The Lipid profile and thyroid profile of the subjects were assessed by the Abbott (USA) automatic analyzers at Diagnostic Laboratories of SMHS Hospital. A total of 200 subjects (100 cases and 100 controls) were included. The sample size was calculated using a "G" power analysis to detect a significant difference in lipid levels between cases and controls, with an assumed power of 80% and a significance level of 0.05. Controls were selected based on age and sex matching with hyperthyroidism cases, ensuring they were euthyroid with no history of thyroid dysfunction, chronic diseases, or use of lipid-lowering drugs.Data were analyzed using descriptive statistics, t-tests, and chi-square tests to compare lipid profiles. Multivariate logistic regression was performed to assess the association between hyperthyroidism and lipid abnormalities, adjusting for potential confounders. A p-value $< 0.05$ was considered statistically significant. **Results:** In this study, hyperthyroid patients (n=100) had significantly lower total cholesterol (145.3 ± 32.1 mg/dL vs. 174.6 ± 28.5 mg/dL; $p < 0.001$), LDL-C (88.2 ± 21.4 mg/dL vs. 103.7 ± 19.9 mg/dL; $p < 0.001$), and HDL-C (34.4 ± 9.6 mg/dL vs. 42.3 ± 10.3 mg/dL; $p < 0.001$) compared to controls (n=100). Triglycerides were elevated in hyperthyroid patients (176.9 ± 37.8 mg/dL vs. 145.2 ± 34.3 mg/dL; $p < 0.001$), indicating significant dyslipidemia associated with hyperthyroidism. **Conclusion** In our study we observed subjects with dyslipidemia, a thyroid function test is crucial for the detection of thyroid dysfunction. It is also crucial for any individuals whose lipid profile unexpectedly improves or deteriorates. Therefore, patients with dyslipidemia who have underlying thyroid abnormalities should be identified and treated, particularly if the results are unexpected.

**Key words:** Hyperthyroidism, dyslipedmia, Kashmir, Lipids, Thyroid.



## INTRODUCTION

In the endocrine disorders the most prevalent endocrine disorders in the world is thyroid disease. India is hardly an exception either. Based on projections from multiple thyroid disease research, the projected number of thyroid disease cases in India is approximately 42 million [1]. Thyroid disorders are distinct from other illnesses in that they are simpler to diagnose, more readily available medical care, and somewhat visible thyroid swelling to the attending physician.

The cornerstone of management continues to be early diagnosis and therapy [1]. Changes in the concentration of thyroid hormone impact an individual's ability to grow and develop, regulate their body temperature, use oxygen, function of their nerves, and react to other hormones. They affect the way that fats, proteins, carbohydrates, vitamins, nucleic acids, and inorganic anions and cations are metabolized [2]. When

DOI: 10.69605/ijlbpr_13.8.2024.92

hormones are produced in high quantities, the basal metabolic rate rises. Additionally, food is used for energy generation at a pace that is significantly faster. There is an increase in the rate of protein synthesis. Overall, the body's functional activity has increased more broadly. Growth is impacted by thyroid hormone in both general and particular ways [3]. Thyroid hormones have a variety of effects that improve fat metabolism. They cause the plasma's concentration of fatty acids to rise, the fat tissues to mobilise more quickly, and the cells' oxidation of free fatty acids to speed up [3]. Thyroid disorders cause significant disruptions to the transit and composition of lipoproteins. Each patient's change in plasma lipid is unique in terms of magnitude [4]. The severity and length of the thyroid dysfunction determine how much of these alterations occur [5]. Hyperthyroidism exhibits an enhanced excretion of cholesterol and increased turnover of low density lipoprotein (LDL) resulting in a decrease total cholesterol and LDL cholesterol. Plasma LDL level decreases in hyperthyroidism [4]. The pace at which chylomicrons are cleared and triglycerides are turned over is enhanced by thyroid hormones. Furthermore, there was a decrease in hypothyroidism and an increase in hyperthyroidism in the liver's lipogenic capacity. Because of a lower rate of re-esterification and an increase in the oxidation of freshly synthesised fatty acids at the same time, the thyroid hormones diminish the amount of total cholesterol and very low density lipoprotein (VLDL) produced by the liver. An increased VLDL secretion by the liver was seen in hypothyroid patients [8]. Valdermarsson et al. reported elevated plasma triglyceride in hypothyroidism [9]. The LDL/High density lipoprotein (HDL) ratio was high in hypothyroidism and low in hyperthyroidism [10].

The hyperthyroidism is characterized by elevated thyroid hormone synthesis and its release from the thyroid gland [11]. Numerous research have examined the frequency of hyperthyroidism in India. Subclinical and overt hyperthyroidism were found in 1.6% and 1.3% of participants in a community survey [12], respectively, in an epidemiological investigation from Cochin.In a Pondicherry-based study conducted in a hospital, 0.6% and 1.2% of the participants had subclinical and overt hyperthyroidism, respectively [13].The basis for the laboratory diagnosis of hyperthyroidism is serum thyroid-stimulating hormone (TSH), as well as serum hormones (T4) and (T3). While T4 and T3 levels are high, TSH levels are low [14]. Hyperthyroidism is frequently characterized by tachycardia, restlessness, tremor, weakness, and heat sensitivity in addition to weight loss despite an increase in appetite [15]. Other signs of hyperthyroidism were considered, including agitation and anxiety, sweating, insomnia, and diarrhea [16].Subclinical hyperthyroidism has two types of causes: endogenous and external. The thyroid gland's overproduction of thyroid hormone is the most common endogenous cause of endogenous subclinical hyperthyroidism [17]. Individual differences in lipid diseases are significant [4]. There is ample evidence linking high cholesterol to the chance of developing coronary heart disease [18]. Therefore, the goal of the current study was to determine how changes in lipid levels relate to hyperthyroidism. This would undoubtedly assist in the early diagnosis of lipid abnormalities in patients suffering from hyperthyroidism, hence lowering the morbidity and mortality associated with these conditions.

## MATERIALS METHODS

### Subjects and recruitment process

This case-control study was conducted at the Post graduate Department of Physiology, in collaboration with Department of Endocrinology Government Medical College Srinagar from 2022 to 2024. All the patients were referred from Out-Patient Department (OPD) and Inpatient Department (IPD) of Government Medical College Srinagar and its associated Shri-Maharaja Hari Singh Hospital (SMHS) Hospital, a major referral hospital of Kashmir valley, to the diagnostic Laboratories of Biochemistry for the evaluation of thyroid function test and lipid profile. The study was approved by Institutional ethical committee of Government Medical College (GMC) Srinagar. Individuals who fulfilled exclusion criteria for hyperthyroidism diseases and gave consent to participate in the study were recruited as normal. All the Subjects' information was kept confidential. Patients and normal subjects recruited for study were age matched and gender matched.

**Sample size:** A total of 200 subjects were selected for the study. These included the hyperthyroid untreated (n=100), and normal-controls (n=100).The sample size was determined using the following formula for case-control studies:

$$n = \left( \frac{(Z_{\alpha/2} + Z_{\beta})^2 \times 2 \times p \times (1-p)}{(p_1 - p_2)^2} \right)$$

Where:

- n = required sample size per group
- Zα/2 = Z-value corresponding to a 95% confidence level
- Zβ = Z-value corresponding to 80% power
- p1 = expected proportion of lipid abnormalities in the hyperthyroid group.
- p2 = expected proportion of lipid abnormalities in the control group.
- p = (p_1 + p_2)/2 = (0.65 + 0.45)/2 = 0.55
- p1−p2 = expected difference between cases and controls (0.20)

Using these values, the required sample size per group was calculated as follows:

DOI: 10.69605/ijlbpr_13.8.2024.92

$$n = \left( \frac{(1.96 + 0.84)^2 \times 2 \times 0.55 \times (1 - 0.55)}{(0.20)^2} \right)$$

$$n = \left( \frac{7.84 \times 2 \times 0.55 \times 0.45}{0.04} \right) \approx 92.2$$

Thus, the calculated sample size for each group was approximately 92 participants. To account for potential dropouts and incomplete data, the final sample size was rounded up to 100 participants in each group, resulting in a total of 200 participants (100 hyperthyroid patients and 100 controls).

**Exclusion criteria:** Patients with heart disease, cerebrovascular and neurological diseases, diabetes mellitus, chronic renal impairment, known psychological illnesses, previous history of thyroid disease or previous thyroxine therapy, asthma and pregnancy.

**Inclusion criteria:** Hyperthyroid patients, Kashmiri ethnicity, normal patient.

**Blood Sample collection**

About 5-6 ml of venous blood was collected, 5 ml was centrifuged to separate serum from the cells as soon as the clot was formed.

**Measurement of Lipid Profile Parameters**

The 3ml venous blood was taken in sterilized Lithium Heparin Green top vials. Levels of total cholesterol, triglycerides, HDL-C and LDL-cholesterol (LDL-C) were estimated by Chemiluminisence method.

**Measurement of thyroid hormone profile**

Serum aliquots were stored at 4ºC to be run in batches. The samples were allowed to thaw prior to assay, mixed thoroughly. Hemolysed and lipemic samples were rejected. Bi level i.e. high and low control was run with each batch . Thyroid function test (TFT) comprising of FT3, FT4, T3, T4 and TSH levels was carried out by chemiluminescence **I**mmuno**a**ssay method using fully automatic analyzer Allinity i(Abbott, USA).

**Statistical Analysis**

Data were analyzed using SPSS version 21.1 (Chicago, IL). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages. Comparisons between cases and controls were made using independent t-tests for normally distributed continuous variables and the Mann-Whitney U test for non-normally distributed variables. Categorical variables were compared using the chi-square test.A multivariate logistic regression analysis and post hoc analysis was conducted to identify the independent predictors of lipid abnormalities in hyperthyroid patients. A p-value of less than 0.05 was considered statistically significant.

## RESULTS

Demographic and Clinical Characteristics of Study Population

Table 1 shows the baseline characteristics of the 200 participants (100 cases and 100 controls). The mean age, gender distribution, and BMI were similar between both groups.

| Variable | Cases (n=100) | Controls (n=100) | p-value |
|---|---|---|---|
| Age (years) | 42.5 ± 10.2 | 41.8 ± 9.7 | 0.68 |
| Gender (M/F) | 35/65 | 34/66 | 0.89 |
| BMI (kg/m²) | 24.3 ± 3.8 | 23.9 ± 3.6 | 0.44 |
| Duration of Hyperthyroidism (months) | 8.4 ± 3.2 | N/A | N/A |

There were no significant differences in age, gender distribution, or BMI between cases and controls, indicating that the groups were well matched for these variables. The mean duration of hyperthyroidism in cases was 8.4 months. Sex-wise distribution of hyperthyroidism patients is shown as Histogram (Figure 1).

DOI: 10.69605/ijlbpr_13.8.2024.92

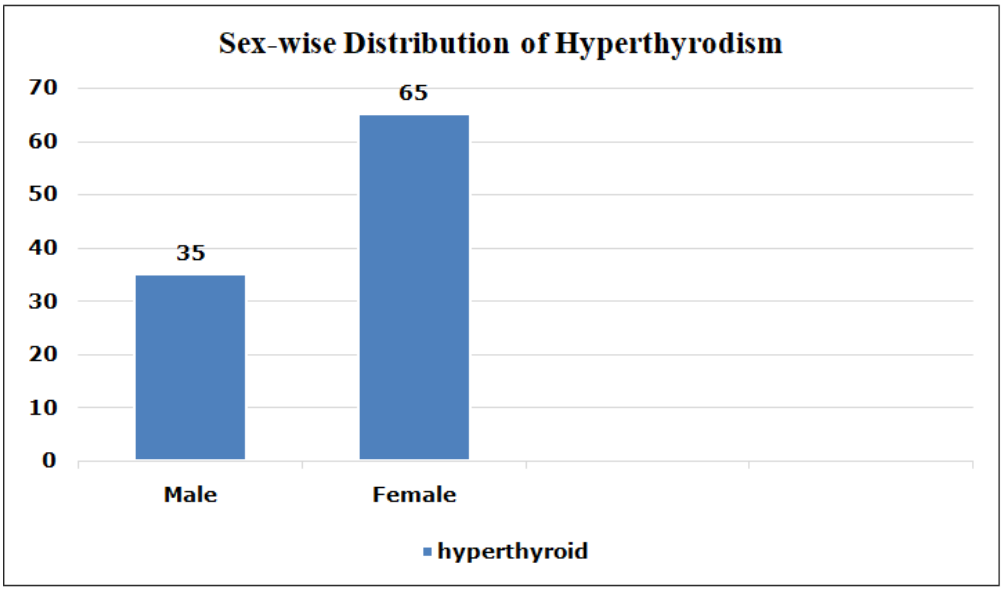


**Figure 1: Histogram showing distribution of hyperthyroidism in both Genders.**

**Table 2. Comparison of Thyroid profile between hyperthyroidism and normal.**

| Parameters | Control N=100 | Hyperthyroidism N=100 | P Value |
|---|---|---|---|
| T3 (0.6-1.6 ng/ml) | 1.4 ± 0.2 | 5.8 ± 0.85 | <0.001 |
| T4 (4.8-11.72 ug/dl) | 10.4 ± 1.6 | 23.4 ± 3.6 | <0.001 |
| TSH (0.35 to 5.0 uIU/ml) | 3.2 ± 1.8 | 0.01 ± 0.1 | <0.001 |
| FT3 (1.7-3.7 pg/ml) | 2.5±1.2 | 5.3±0.4 | <0.001 |
| FT4 (0.7-1.48 ng/dl) | 1.2±0.4 | 3.3±0.5 | <0.001 |
| Anti-TPO (0.00-5.61 IU/ml) | 3.5±1.5 | 220±48.5 | <0.001 |

(Abbreviations:- T3: Triiodothyronine, T4: Thyroxine, TSH: Thyroid Stimulating Hormone, FT3: Free triiodothyronine, FT4: Free Thyroxine, Anti-TPO's: Anti-Thyroid Peroxidase).

Summarized in Table 2: In the group I (Controls), the levels of thyroid profile parameters are as: T3: 1.4 ± 0.2, T4: 10.4 ± 1.6,TSH: 3.2 ± 1.8, FT3: 2.5±1.2, FT4: 2.5±1.2, Anti-TPO: 3.5±1.5. Whereas, in group II (Hyperthyroidism), thyroid profile parameters are as: T3: 5.8 ± 0.85, T4: 23.4 ± 3.6, TSH: 0.01 ± 0.1, FT3: 5.3±0.4, FT4: 3.3±0.5, Anti-TPO: 220±48.5. Across the groups all thyroid profile are stastically significant ($p<0.001$).

**Table 3: Comparison of Blood Pressure among cases and controls.**

| Blood Pressure | Controls N=100 | Cases N=100 | P-Value |
|---|---|---|---|
| Systolic Blood Pressure (mm/Hg) | 115±2.5 | 132±2.5 | 0.003 |
| Diastolic Blood Pressure (mm/Hg) | 78±1.5 | 84±2.5 | 0.004 |

Table 3, shows both systolic blood pressure and diastolic blood pressure was significantly different among both groups, $p<0.005$. In hyperthyroid cases Systolic Blood Pressure was :132±2.5, Diastolic Blood Pressure: 84±2.5. whereas, in controls, systolic blood pressure: 115±2.5 and diastolic blood pressure: 78±1.5.

DOI: 10.69605/ijlbpr_13.8.2024.92

**Table 4: Comparison of Lipid Profile in hyperthyroid cases and controls.**

| Parameters | Hyperthyroid cases N=100 | Controls N=100 | P-Value |
|---|---|---|---|
| Triglycerides (70-180 mg/dl) | 172.3±38.1 | 145.6±35.2 | <0.001 |
| Total Cholesterol (80-200 mg/dl) | 150.4±32.7 | 176.8±28.5 | <0.001 |
| LDL (30-130 mg/dl) | 89.5±21.3 | 104.7±20.1 | <0.001 |
| HDL (40-60 mg/dl) | 35.2±9.5 | 42.7±10.4 | <0.001 |

(TG: Triglycerides, TC: Total-Cholesterol, HDL: High density Lipoprotein, LDL: Low Density Lipoprotein).

Table 4 shows the comparison of lipid profiles between hyperthyroid patients and euthyroid controls. Hyperthyroid patients had significantly lower levels of total cholesterol, LDL-C, and HDL-C, while triglycerides were significantly higher in cases compared to controls. Hyperthyroid patients exhibited significant dyslipidemia characterized by reduced levels of total cholesterol, LDL-C, and HDL-C, and elevated levels of triglycerides compared to controls. Also, changes were reflected in the histogram shown in figure 2.

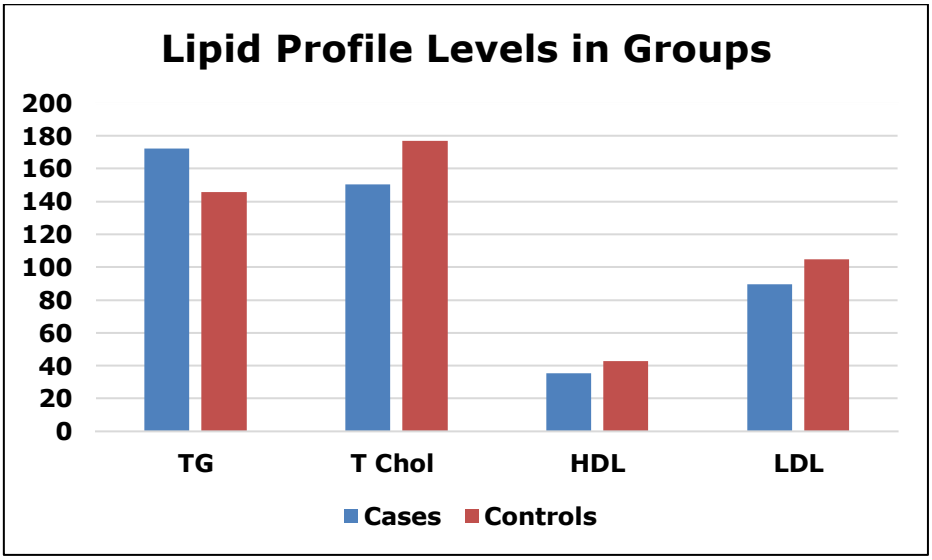


**Figure 2: Histogram showing levels of lipid profile in hyperthyroid cases and controls**

Table 5: Association Between Hyperthyroidism and Lipid Abnormalities

| Lipid Parameter | Adjusted Odds Ratio (95% CI) | p-value |
|---|---|---|
| Total Cholesterol | 0.65 (0.48–0.88) | 0.004 |
| LDL-C | 0.72 (0.55–0.95) | 0.02 |
| HDL-C | 0.58 (0.41–0.81) | <0.001 |
| Triglycerides | 1.53 (1.21–1.96) | <0.001 |

Table 5 presents the multivariate logistic regression analysis assessing the association between hyperthyroidism and lipid abnormalities after adjusting for potential confounders (age, gender, BMI).Hyperthyroidism was significantly associated with lower odds of high total cholesterol, LDL-C, and HDL-C, and higher odds of elevated triglycerides even after adjusting for confounders. This indicates that hyperthyroidism leads to a distinctive pattern of lipid abnormalities.

Table 6: Correlation Between Thyroid Hormones and Lipid Parameters in Hyperthyroid Patients

| Parameter | Free T3 | Free T4 | TSH |
|---|---|---|---|
| Total Cholesterol | -0.47* | -0.42* | 0.39* |

DOI: 10.69605/ijlbpr_13.8.2024.92

| | | | |
|---|---|---|---|
| **LDL-C** | **-0.34*** | **-0.28*** | **0.31*** |
| **HDL-C** | **-0.29*** | **-0.27*** | **0.24*** |
| **Triglycerides** | **0.41*** | **0.35*** | **-0.37*** |

Table 6 shows the correlation between thyroid hormone levels (free T3, free T4, and TSH) and lipid parameters in hyperthyroid cases.Free T3 and free T4 levels were negatively correlated with total cholesterol, LDL-C, and HDL-C, while TSH levels were positively correlated with these lipid parameters. In contrast, free T3 and free T4 were positively correlated with triglyceridesindicating that higher thyroid hormone levels promote hypertriglyceridemia in hyperthyroid patients.

The post hoc analysis was conducted to explore the relationships between different lipid parameters in hyperthyroid patients and euthyroid controls in greater depth. The aim was to identify specific differences between the two groups and determine whether there were any significant variations within subgroups based on age, gender, or BMI.

Table 7: Post Hoc Analysis of Lipid Abnormalities by Age Group

| Age Group | Lipid Parameter | Cases (n=100) | Controls (n=100) | p-value |
|---|---|---|---|---|
| **<40 years (n=70)** | **Total Cholesterol (mg/dL)** | **144.5 ± 30.4** | **170.2 ± 29.1** | **<0.001** |
| | **LDL-C (mg/dL)** | **85.6 ± 19.8** | **101.2 ± 20.0** | **0.004** |
| | **HDL-C (mg/dL)** | **34.1 ± 9.1** | **42.0 ± 10.2** | **<0.001** |
| | **Triglycerides (mg/dL)** | **178.5 ± 36.7** | **148.3 ± 34.5** | **<0.001** |
| **≥40 years (n=130)** | **Total Cholesterol (mg/dL)** | **156.2 ± 33.0** | **181.5 ± 28.0** | **<0.001** |
| | **LDL-C (mg/dL)** | **92.7 ± 22.4** | **107.6 ± 20.1** | **0.002** |
| | **HDL-C (mg/dL)** | **36.2 ± 9.9** | **43.2 ± 10.5** | **<0.001** |
| | **Triglycerides (mg/dL)** | **168.4 ± 37.2** | **143.2 ± 34.8** | **<0.001** |

Table 7 shows the results of a post hoc analysis comparing lipid parameters between hyperthyroid patients and controls stratified by age groups (below 40 years and above 40 years). Across both age groups, hyperthyroid patients had significantly lower levels of total cholesterol, LDL-C, and HDL-C, and significantly higher triglyceride levels compared to controls. These findings were consistent in both younger and older groups, suggesting that lipid abnormalities in hyperthyroidism are not age-dependent.

Table 8: Post Hoc Analysis of Lipid Abnormalities by Gender.

| Gender | Lipid Parameter | Cases (n=100) | Controls (n=100) | p-value |
|---|---|---|---|---|
| **Males (n=69)** | **Total Cholesterol (mg/dL)** | **149.3 ± 31.1** | **175.1 ± 27.9** | **<0.001** |
| | **LDL-C (mg/dL)** | **88.7 ± 20.6** | **103.9 ± 19.8** | **0.003** |
| | **HDL-C (mg/dL)** | **36.4 ± 9.8** | **44.5 ± 11.2** | **<0.001** |
| | **Triglycerides (mg/dL)** | **174.2 ± 39.0** | **146.9 ± 35.7** | **<0.001** |
| **Females (n=131)** | **Total Cholesterol (mg/dL)** | **151.8 ± 34.0** | **178.2 ± 28.9** | **<0.001** |
| | **LDL-C (mg/dL)** | **90.4 ± 21.5** | **105.3 ± 20.2** | **0.002** |
| | **HDL-C (mg/dL)** | **34.5 ± 9.3** | **41.5 ± 9.7** | **<0.001** |
| | **Triglycerides (mg/dL)** | **171.1 ± 37.4** | **144.8 ± 34.4** | **<0.001** |

Table 8 provides the results of the post hoc analysis comparing lipid parameters between hyperthyroid patients and controls, stratified by gender.Both male and female hyperthyroid patients exhibited significantly lower total cholesterol, LDL-C, and HDL-C levels, along with significantly higher triglyceride levels compared to controls. The patterns of lipid abnormalities were similar in both genders, suggesting no gender-specific effects of hyperthyroidism on lipid metabolism.

Table 9: Post Hoc Analysis of Lipid Abnormalities by BMI

| BMI Category | Lipid Parameter | Cases (n=100) | Controls (n=100) | p-value |
|---|---|---|---|---|

DOI: 10.69605/ijlbpr_13.8.2024.92

| | | | | |
|---|---|---|---|---|
| **BMI < 24 (n=96)** | **Total Cholesterol (mg/dL)** | **145.7 ± 30.2** | **172.5 ± 27.3** | **<0.001** |
| | **LDL-C (mg/dL)** | **86.9 ± 19.7** | **101.7 ± 19.4** | **0.004** |
| | **HDL-C (mg/dL)** | **34.0 ± 9.0** | **42.1 ± 10.0** | **<0.001** |
| | **Triglycerides (mg/dL)** | **175.9 ± 36.8** | **146.2 ± 34.1** | **<0.001** |
| **BMI ≥ 24 (n=104)** | **Total Cholesterol (mg/dL)** | **154.1 ± 33.4** | **181.0 ± 29.4** | **<0.001** |
| | **LDL-C (mg/dL)** | **91.8 ± 22.6** | **106.3 ± 20.2** | **0.002** |
| | **HDL-C (mg/dL)** | **36.8 ± 10.0** | **43.5 ± 10.8** | **<0.001** |
| | **Triglycerides (mg/dL)** | **169.7 ± 38.5** | **144.1 ± 35.4** | **<0.001** |

Table 8 presents the post hoc analysis comparing lipid parameters between hyperthyroid patients and controls, stratified by BMI (below and above the median value of 24 kg/m²).Regardless of BMI category, hyperthyroid patients demonstrated significant lipid abnormalities compared to controls, with lower cholesterol, LDL-C, and HDL-C levels, and higher triglycerides. These results indicate that the impact of hyperthyroidism on lipid metabolism is independent of BMI.

## DISCUSSION

Hyperthyroidism, characterized by excess production of thyroid hormones, has profound effects on various metabolic processes, including lipid metabolism. This hospital-based case-control study sought to investigate the association between lipid abnormalities and hyperthyroidism among patients in Kashmir, contributing to the growing body of literature on thyroid dysfunction and cardiovascular risk.Worldwide the prevalence of endocrine disorders is rising, with thyroid dysfunction being more prevalent [19]. Circulating Lipids are greatly impacted by thyroid dysfunction, which is also linked to a variety of other clinical risk factors[20].Our study demonstrated that hyperthyroid patients exhibit significant dyslipidemia compared to euthyroid controls, characterized by lower levels of total cholesterol, LDL-C, and HDL-C, and elevated triglyceride levels[21]. These findings align with previous research, which shows that hyperthyroidism accelerates lipid metabolism and alters the normal lipid profile, potentially increasing cardiovascular risk [22]. This dyslipidemic profile is particularly concerning because elevated triglycerides and reduced HDL-C are known risk factors for atherosclerosis and cardiovascular disease. Despite lower total cholesterol and LDL-C levels, which are typically associated with reduced cardiovascular risk, hyperthyroid patients' elevated triglyceride levels may contribute to the development of cardiovascular complications such as coronary artery disease (CAD) [23].Thyroid hormones (T3 and T4) play a crucial role in regulating lipid metabolism. Thyroid hormone receptors are present in various tissues, including the liver, which is a key organ in cholesterol and triglyceride metabolism. In hyperthyroidism, elevated levels of T3 and T4 increase hepatic LDL receptor activity, leading to enhanced clearance of LDL particles from circulation . This explains the lower levels of LDL-C and total cholesterol observed in hyperthyroid patients. Moreover, thyroid hormones upregulate enzymes involved in lipolysis, promoting the breakdown of fat stores into free fatty acids, which are then converted into triglycerides in the liver. This contributes to the elevated triglyceride levels seen in hyperthyroid patients . The increased production of triglycerides can also lead to hepatic steatosis (fatty liver), which may exacerbate the cardiovascular risk associated with hyperthyroidism .Several studies have reported similar findings regarding the lipid profiles of hyperthyroid patients. For instance, a study by Monzani et al. found that hyperthyroid patients had significantly lower LDL-C and HDL-C levels and higher triglyceride levels compared to euthyroid controls[24] . Similarly, an Indian study by Bandyopadhyay et al. reported that hyperthyroid patients exhibited lower total cholesterol and HDL-C levels and elevated triglycerides, consistent with our findings [25].However, the magnitude of these lipid abnormalities varies across studies, likely due to differences in study populations, thyroid hormone levels, and other factors such as diet and lifestyle. In particular, geographic and ethnic differences may contribute to variations in lipid profiles, as observed in our study population from Kashmir . The unique dietary habits and genetic background of this population may have influenced the observed lipid abnormalities.The cardiovascular implications of lipid abnormalities in hyperthyroid patients are of significant concern. Although lower LDL-C levels are generally considered cardioprotective, the concomitant elevation of triglycerides and reduction in HDL-C may negate these protective effects . Elevated triglycerides and low HDL-C levels are well-established risk factors for atherosclerosis, which can lead to plaque formation and increase the risk of coronary artery disease[26] .Furthermore, hyperthyroidism itself is associated with increased cardiac output, tachycardia, and hypertension, all of which contribute to a higher cardiovascular risk profile . When combined with the dyslipidemic profile observed in our study, hyperthyroid patients may be at an increased risk of developing cardiovascular complications such as myocardial infarction and stroke. It is, therefore, essential for clinicians to closely monitor lipid levels and cardiovascular health in hyperthyroid patients, even if their LDL-C levels appear normal[28-29] . One of the most striking findings of our study was the significant elevation in triglyceride levels in hyperthyroid patients. This

DOI: 10.69605/ijlbpr_13.8.2024.92

finding is consistent with previous studies showing that hyperthyroidism leads to increased lipolysis and hepatic triglyceride production. Elevated triglycerides are associated with an increased risk of pancreatitis and cardiovascular events, particularly in the context of metabolic syndrome .In hyperthyroid patients, elevated triglyceride levels may also reflect underlying insulin resistance, which is often observed in hyperthyroidism . Insulin resistance is a key component of metabolic syndrome and is associated with increased triglyceride synthesis and impaired clearance of triglyceride-rich lipoproteins. This suggests that hyperthyroid patients with elevated triglycerides may be at higher risk of developing metabolic syndrome and its associated complications . The post hoc analysis stratified by age, gender, and BMI revealed that lipid abnormalities in hyperthyroid patients were consistent across these subgroups. Both younger and older patients, as well as males and females, exhibited similar patterns of dyslipidemia[30]. This finding contrasts with some studies that suggest gender differences in lipid metabolism, where males often exhibit more pronounced lipid changes than females . However, our results suggest that the effects of hyperthyroidism on lipid metabolism are robust and not significantly influenced by gender or age.Similarly, lipid abnormalities were observed in both lower and higher BMI categories, indicating that BMI does not significantly modify the relationship between hyperthyroidism and lipid metabolism. This finding is important because it suggests that all hyperthyroid patients, regardless of their BMI, should be monitored for lipid abnormalities and cardiovascular risk .Given the observed lipid abnormalities, it is crucial for clinicians to recognize the potential cardiovascular risks associated with hyperthyroidism. Even though hyperthyroid patients may have lower LDL-C levels, their elevated triglyceride levels and reduced HDL-C levels warrant careful management . Clinicians should consider lipid-lowering therapies, particularly targeting elevated triglycerides, to reduce the risk of cardiovascular events.The management of hyperthyroidism itself is also critical for normalizing lipid levels. In addition to treating hyperthyroidism, lifestyle interventions such as dietary modifications, increased physical activity, and weight management should be encouraged in patients with dyslipidemia . Dietary interventions aimed at reducing triglyceride levels, such as limiting refined carbohydrates and increasing omega-3 fatty acids, may be particularly beneficial for hyperthyroid patients with elevated triglycerides .Despite the strengths of our study, including a well-matched case-control design and the use of robust statistical methods, there are some limitations to consider. First, the study was conducted in a single center in Kashmir, which may limit the generalizability of the findings to other populations with different genetic and environmental factors . Second, we did not measure certain lipid subfractions, such as small dense LDL particles, which may provide additional insights into the cardiovascular risk associated with hyperthyroidism . Future studies should consider including these lipid subfractions to better understand the complex relationship between thyroid dysfunction and cardiovascular risk.Additionally, the cross-sectional design of our study limits the ability to establish causality between hyperthyroidism and lipid abnormalities. Longitudinal studies are needed to confirm these findings and explore the long-term impact of hyperthyroidism on lipid metabolism and cardiovascular outcomes . Future research should focus on exploring the underlying mechanisms by which hyperthyroidism leads to lipid abnormalities and the potential role of genetic factors in modulating these effects. Additionally, studies should investigate the impact of different treatment modalities for hyperthyroidism on lipid profiles and cardiovascular risk .Given the significant elevation in triglycerides observed in hyperthyroid patients, further research should also explore the role of triglyceride-lowering therapies in this population. Pharmacological agents such as fibrates and omega-3 fatty acids may have a role in managing hypertriglyceridemia in hyperthyroid patients .

## CONCLUSION AND RECOMMENDATIONS

This hospital-based case-control study demonstrates a significant association between hyperthyroidism and lipid abnormalities in patients from Kashmir. Hyperthyroid patients exhibited a distinct dyslipidemic profile, characterized by lower levels of total cholesterol, LDL-C, and HDL-C, alongside elevated triglycerides levels. These lipid abnormalities, especially the elevated triglycerides and reduced HDL-C, suggest an increased risk of cardiovascular complications, despite lower LDL-C levels typically associated with reduced cardiovascular risk.The findings underscore the need for clinicians to monitor lipid profiles in hyperthyroid patients closely and to recognize that hyperthyroidism may increase cardiovascular risk through mechanisms beyond LDL-C levels alone. Although treating hyperthyroidism itself often leads to improvements in lipid levels, specific interventions targeting elevated triglycerides and reduced HDL-C should also be considered to mitigate cardiovascular risks.

### Recommendations

1. **Routine Lipid Screening**: Hyperthyroid patients should undergo regular lipid profile screening, with particular attention to triglyceride and HDL-C levels.
2. **Management of Dyslipidemia**: Lifestyle interventions, such as dietary changes and increased physical activity, should be promoted, and pharmacologic treatment may be necessary in cases of severe dyslipidemia.

DOI: 10.69605/ijlbpr_13.8.2024.92

3. **Further Research**: Longitudinal studies are needed to explore the long-term cardiovascular outcomes of lipid abnormalities in hyperthyroidism and to identify effective therapeutic strategies for managing these risks.

**Conflict of Interest:** Nil
**Funding**: Nil

## REFERENCES

1. Unnikrishnan AG, Menon UV. Thyroid disorders in India: An epidemiological perspective. Indian J Endocrinol Metab 2011;15:S78-81.
2. Hoch FL. Biochemistry of hyperthyroidism and hypothyroidism. Postgrad Med J 1968;44:347-62.
3. Guyton H. Text Book of Medical Physiology. 11th ed., Ch. 76. United States: Harcourt Asia and Saunders; 2006. p. 935-6.
4. Duntas LH. Thyroid disease and lipids. Thyroid 2002;12:287-93.
5. Diekman MJ, Anghelescu N, Endert E, Bakker O, Wiersinga WM. Changes in plasma LDL and HDL cholesterol in hypo and hyperthyroide patients are related to changes in free thyroxine, not to polymorphism in LDL receptor or cholesterol ester transfer protein genes. J ClinEndocrin Met 2000;85:1857.
6. Biondi B, Klein I. Hypothyroidism as a risk factor for cardiovascular disease. Endocrine 2004;24:1-13.
7. Gomo Z, Ascott MB. The association of serum thyroid stimulating hormone and serum lipids and lipoproteins in patients with suspected hypothyroidism. Cent Afr J Med 1994;40:94-8.
8. Müller MJ, Seitz HJ. Thyroid hormone action on intermediary metabolism. Part II: Lipid metabolism in hypo- and hyperthyroidism. KlinWochenschr 1984;62:49-55.
9. Valdermarsson S, Hansson P, Hender P, Nilsson-Ehle P. Relations between thyroid fuction, hepatic and lipoprotein lipase activities and plasma lipoprotein concentrations. ActaEndocrinol (Copenh) 1983;104:50-6
10. Bauer DC, Ettinger B, Browner WS. Thyroid functions and serum lipids in older women: A population-based study. Am J Med 1998;104:546-51.
11. Kahaly GJ, Bartalena L, Hegedüs L, Leenhardt L, Poppe K, Pearce SH. 2018 European Thyroid Association Guideline for the Management of Graves' Hyperthyroidism. Eur Thyroid J. 2018 Aug;7(4):167-186.
12. UshaMenon V, Sundaram KR, Unnikrishnan AG, Jayakumar RV, Nair V, Kumar H. High prevalence of undetected thyroid disorders in an iodine sufficient adult south Indian population. *J Indian Med Assoc*. 2009;107:72–7.
13. Abraham R, Murugan VS, Pukazhvanthen P, Sen SK. Thyroid Disorders In Women of Puducherry. *Indian J ClinBiochem*. 2009;24:52–9.
14. Ross DS, Burch HB, Cooper DS, Greenlee MC, Laurberg P, Maia AL, Rivkees SA, Samuels M, Sosa JA, Stan MN, Walter MA. 2016 American Thyroid Association Guidelines for Diagnosis and Management of Hyperthyroidism and Other Causes of Thyrotoxicosis. Thyroid. 2016 Oct;26(10):1343-1421.
15. Zader SJ, Williams E, Buryk MA. Mental Health Conditions and Hyperthyroidism. Pediatrics. 2019 Nov;144(5):e20182874.
16. Leo M, Bartalena L, RotondoDottore G, Piantanida E, Premoli P, Ionni I, Di Cera M, Masiello E, Sassi L, Tanda ML, Latrofa F, Vitti P, Marcocci C, Marinò M. Effects of selenium on short-term control of hyperthyroidism due to Graves' disease treated with methimazole: results of a randomized clinical trial. J Endocrinol Invest. 2017 Mar;40(3):281-287.
17. Santos Palacios S, Pascual-Corrales E, Galofre JC. Management of subclinical hyperthyroidism. Int J Endocrinol Metab. 2012 Spring;10(2):490-6.
18. Agdeppa D, Macaron C, Mallik T, Schnuda ND. Plasma high density lipoprotein cholesterol in thyroid disease. J ClinEndocrinol Metab 1979;49:726-9.
19. Garnie MA, Zargar AH. Scenarion of endocrinology in South Asia. India EndrocrinolMetabol 2007;11:1-2.
20. Kung AW, Pang RW, Launder I, Lam KS, Janus ED. Changes in serum lipoprotein(a) and lipids during treatment of hyperthyroidism. ClinChem 1995;41:L226- 31.
21. Aviram M, Luboshitzk R, Brook JG. Lipid and lipoprotein pattern in thyroid dysfunction and the effect of therapy. ClinBiochem 1982;15:62-6.
22. Deschampheleire M, Luyckx FH, Scheen AJ. Thyroid disorders and dyslipidemias. Rev Med Liege 1999;54:746-50.
23. Nishitani H, Okamura K, Noguchi S, Inoue K, Morotomi Y, Fujishima M. Serum lipid levels in thyroid dysfunction with special reference to transient elevation during treatment in hyperthyroid Graves' disease. Horm Metab Res 1990;22:490-3.
24. Monzani F, Caraccio N, Kozakowa M, Dardano A, Ferrannini E, Antonangeli L, et al. Effect of thyroid hormone on the low-density lipoprotein (LDL) receptor gene expression in human cells: relevance to LDL metabolism in hyperthyroidism. J ClinEndocrinol Metab. 2000;85(2):835-39.
25. Bandyopadhyay SK, Das SK, Dutta D, Mukherjee D. Lipid profiles in hyperthyroid patients and the effect of treatment on lipid profile status in a tertiary care center. Indian J Endocrinol Metab. 2012;16(3):367-69.
26. Stone NJ, Robinson JG, Lichtenstein AH, Merz CN, Blum CB, Eckel RH, et al. Treatment of blood cholesterol to reduce atherosclerotic cardiovascular risk in adults: 2013 ACC/AHA guideline. Circulation. 2014;129(25 Suppl 2)
27. Duntas LH, Brenta G. The effect of thyroid disorders on lipid levels and metabolism. Med Clin North Am. 2012;96(2):269-81.
28. Klein I, Danzi S. Thyroid disease and the heart. Circulation. 2007;116(15):1725-35.
29. Parle JV, Franklyn JA, Cross KW, Jones SR, Sheppard MC, Appelton DS. Thyroxine replacement therapy and circulating lipid concentrations. ClinEndocrinol (Oxf). 1992;37(5):411-17.
30. Pankow JS, Duncan BB, Schmidt MI, Ballantyne CM, Couper DJ, Hoogeveen RC, et al. Fasting plasma free fatty acids and risk of type 2 diabetes: The atherosclerosis risk in communities study. Diabetes Care. 2004;27(1):77-82.