e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(7); 1992-1996

Original Research Article

Exploring the Link Between Thyroid Hormones and Triglyceride Profiles in Type 2 Diabetes Patients

Pramod Kumar[1], Ajay Lal Das[2]

[1]Assistant Professor, Department of Medicine, Madhubani Medical College, Madhubani, Bihar, India
[2]Professor, Department of Medicine, Madhubani Medical College Madhubani, Bihar, India

Received: 17-05-2025 / Revised: 16-06-2025 / Accepted: 17-07-2025
Corresponding Author: Pramod Kumar
Conflict of interest: Nil

Abstract:

Background: Lipid abnormalities are often linked to type 2 diabetes, which raises the risk of cardiovascular disease. Thyroid hormones are essential for controlling lipid metabolism, and even mild thyroid impairment can affect a diabetic's blood triglyceride levels.

Aim: To assess the relationship between triglyceride levels and plasma thyroid hormone concentrations in individuals with T2DM.

Methods: One hundred T2DM patients who were seen at a tertiary care endocrinology clinic participated in a cross-sectional analytical study. We gathered information on fasting triglycerides, thyroid hormone levels (Free T3, Free T4, and TSH), duration of diabetes, and demography (BMI). Thyroid status was used to group the patients. SPSS version 23.0 was used to conduct the statistical analysis. The correlation between thyroid hormones and triglyceride levels was evaluated using regression and correlation analysis.

Results: The mean age of participants was 56.2 ± 8.7 years, with 52% males. Subclinical hypothyroidism was present in 18% of participants, and this group showed significantly higher triglyceride levels (210.6 ± 52.4 mg/dL) compared to euthyroid individuals (178.5 ± 38.9 mg/dL, $p = 0.022$). Pearson correlation revealed significant negative correlations between triglyceride levels and Free T3 ($r = -0.321$, $p = 0.001$) and Free T4 ($r = -0.278$, $p = 0.005$), while TSH was positively correlated ($r = 0.346$, $p < 0.001$). Regression analysis confirmed thyroid hormones as independent predictors of triglyceride levels.

Conclusion: Elevated triglyceride concentrations in patients with type 2 diabetes are substantially correlated with thyroid hormone levels, especially in subclinical hypothyroidism. Even after controlling for diabetes duration and BMI, the connection remains.

Recommendations: Patients with T2DM should be routinely screened for thyroid dysfunction, particularly if they have poor lipid control. In diabetic populations, early detection and treatment of thyroid problems may help lower cardiovascular risk and improve lipid profiles.

Keywords: Type 2 Diabetes Mellitus, Thyroid Hormones, Triglycerides, Subclinical Hypothyroidism, Lipid Metabolism.

Introduction

Insulin resistance and poor glucose metabolism are hallmarks of type 2 diabetes mellitus (T2DM), a chronic metabolic disease. Several comorbidities, including as dyslipidemia, hypertension, and elevated cardiovascular risk, are frequently linked to it. Among these, diabetic dyslipidemia, which is characterized by tiny dense LDL particles, low HDL cholesterol, and high triglycerides, is crucial in hastening atherosclerosis and raising morbidity and mortality in individuals with type 2 diabetes [1,2].

Thyroid hormones play a major role in controlling lipid metabolism and basal metabolic rate. Lipolysis, hepatic cholesterol production, and lipoprotein clearance are all impacted by triiodothyronine (T3) and thyroxine (T4) [3]. It has been demonstrated that even slight changes in thyroid function, such as subclinical hypothyroidism or hyperthyroidism, have a major effect on cardiovascular health and lipid profiles [4]. Given the overlapping metabolic pathways and reciprocal effects on insulin sensitivity, glucose regulation, and lipid management, the interaction between thyroid dysfunction and diabetes is especially significant [5].

According to recent research, lipid problems in people with type 2 diabetes may be made worse by thyroid dysfunction, even if it is subclinical [6]. Because of decreased hepatic expression of the LDL receptor and decreased activity of lipoprotein lipase, subclinical hypothyroidism is linked to elevated

levels of total cholesterol and serum triglycerides [7]. On the other hand, increased thyroid hormones can lower triglyceride levels by improving clearance, but if they are too high, they can potentially be harmful to the heart [8]. Monitoring thyroid status may be crucial for maximizing metabolic control because thyroid impairment is common in diabetic populations, with reports ranging from 10% to 15% [9].

Despite these insights, the correlation between thyroid hormones and lipid profiles in T2DM remains underexplored in many populations. While some studies show a significant correlation between thyroid function and triglyceride levels, others report inconsistent findings, possibly due to differences in ethnicity, treatment status, or study design [10]. Therefore, further investigation is warranted to clarify the relationship between plasma thyroid hormone concentrations and triglyceride levels in T2DM patients.

The purpose of this study is to evaluate the relationship between serum triglycerides and thyroid hormone levels in individuals with type 2 diabetes. By addressing both glycemic control and lipid abnormalities in diabetic patients, more integrated care options may be supported, thus lowering the cardiovascular risk load for these patients.

Methodology

Study Design: This study employed a cross-sectional analytical design.

Study Setting: The study was conducted at the Endocrinology and Diabetes Outpatient Clinic of a tertiary care center. The research was carried out over a period of one year from January 2024 to January 2025.

Participants: A total of 100 adult participants with a confirmed diagnosis of T2DM were recruited consecutively during routine clinical visits. All participants provided informed written consent prior to inclusion in the study.

Inclusion Criteria:

- Adults aged 30 to 70 years
- Diagnosed with T2DM for at least 1 year
- On stable antidiabetic treatment for a minimum of 3 months
- Willing to provide informed consent

Exclusion Criteria:

- Known thyroid disorders or on thyroid medications
- Pregnant or lactating women
- Individuals with renal or hepatic impairment
- Patients on lipid-lowering medications or corticosteroids
- Acute or chronic infections or inflammatory diseases at the time of study

Bias: Selection bias was minimized by using a consecutive sampling technique, ensuring that every eligible patient visiting the clinic during the study period had an equal opportunity to participate. Measurement bias was reduced by using standardized and calibrated equipment, as well as adhering to uniform laboratory procedures for thyroid and lipid testing.

Data Collection: Demographic data including age, gender, duration of diabetes, and BMI were recorded using a structured questionnaire. Blood samples were collected after an overnight fast of at least 8 hours to assess fasting triglyceride levels and thyroid hormone concentrations (Free T3, Free T4, and TSH). Laboratory analyses were performed in the hospital's central diagnostic laboratory using standardized protocols.

Procedure: Participants were evaluated during a single clinic visit. Following informed consent, medical histories were reviewed and anthropometric measurements were taken. Blood samples were drawn by trained phlebotomists and immediately sent for analysis. All biochemical parameters were assessed using automated analyzers. Data were anonymized to ensure confidentiality and stored securely.

Statistical Analysis: Version 23.0 of IBM SPSS Statistics for Windows was used to enter and analyze the data. The data was summarized using descriptive statistics, which include mean ± standard deviation, frequencies, and percentages. Depending on the data distribution, either the Pearson or Spearman correlation tests were used to assess the association between triglyceride concentrations and thyroid hormone levels. P-values below 0.05 were regarded as statistically significant.

Results

A total of 100 patients with (T2DM) were included in the study. The mean age of participants was **56.2 ± 8.7 years**, with **52% male (n=52)** and **48% female (n=48)**. The mean duration of diabetes was **8.4 ± 3.9 years**, and the average Body Mass Index (BMI) was **27.8 ± 3.5 kg/m²**.

Table 1: Baseline Characteristics of Participants (N = 100)

Variable	Mean ± SD / n (%)
Age (years)	56.2 ± 8.7
Gender (Male/Female)	52 (52%) / 48 (48%)
Duration of T2DM (years)	8.4 ± 3.9

BMI (kg/m²)	27.8 ± 3.5
Fasting Triglycerides (mg/dL)	186.7 ± 45.2
Free T3 (pg/mL)	2.8 ± 0.5
Free T4 (ng/dL)	1.3 ± 0.2
TSH (µIU/mL)	2.6 ± 1.1

Thyroid Hormone Status and Triglyceride Levels: Participants were categorized based on thyroid hormone status into Euthyroid (n = 74), Subclinical Hypothyroid (n = 18), and Subclinical Hyperthyroid (n = 8) groups. The mean triglyceride levels varied significantly among these groups.

Table 2: Mean Triglyceride Levels According to Thyroid Status

Thyroid Status	n	Mean Triglycerides (mg/dL)	SD	p-value*
Euthyroid	74	178.5	38.9	
Subclinical Hypothyroid	18	210.6	52.4	
Subclinical Hyperthyroid	8	194.8	47.2	
Total	100	186.7	45.2	**0.022**

*One-way ANOVA test used.

A statistically significant difference (p = 0.022) was observed in triglyceride levels across different thyroid function groups. Patients with subclinical hypothyroidism had higher triglyceride levels compared to euthyroid individuals.

Correlation Between Thyroid Hormones and Triglyceride Levels: Pearson correlation analysis was used to determine the relationship between thyroid hormone levels (FT3, FT4, TSH) and triglyceride levels.

Table 3: Correlation Between Thyroid Hormones and Triglyceride Levels

Parameter	Correlation Coefficient (r)	p-value
Free T3	-0.321	0.001
Free T4	-0.278	0.005
TSH	+0.346	<0.001

Interpretation:

- Free T3 and Free T4 were negatively correlated with triglyceride levels, indicating that lower thyroid hormone levels were associated with higher triglyceride levels.
- TSH was positively correlated, suggesting that elevated TSH levels (as seen in subclinical hypothyroidism) are linked with increased triglycerides.
- All correlations were statistically significant.

Regression Analysis: To further explore predictors of triglyceride levels, a multiple linear regression analysis was conducted, including Free T3, Free T4, TSH, BMI, and duration of diabetes as independent variables.

Table 4: Multiple Linear Regression Predicting Triglyceride Levels

Variable	Beta Coefficient (β)	Standard Error	p-value
Free T3	-12.4	4.3	0.004
Free T4	-9.1	3.7	0.015
TSH	+11.8	3.2	<0.001
BMI	+2.1	1.1	0.056
Duration of Diabetes	+1.3	0.9	0.141

- Free T3, Free T4, and TSH remained significant predictors of triglyceride levels after adjusting for confounding variables.
- BMI and duration of diabetes showed no statistically significant effect in this model.

Summary of Key Findings

- Patients with subclinical hypothyroidism had significantly higher triglyceride levels.
- Free thyroid hormones (FT3, FT4) were inversely related, and TSH was positively related to triglycerides.
- Thyroid hormone levels are significant predictors of triglyceride levels, independent of BMI and diabetes duration.

Discussion

In this study, 100 patients with type 2 diabetes had their triglyceride levels and plasma thyroid hormone levels compared. The results showed that

triglyceride levels varied significantly according to thyroid function status, with subclinical hypothyroidism patients having the highest amounts. There may be a connection between lipid metabolism and even minor thyroid dysfunction, as seen by the group's mean triglyceride level of 210.6 mg/dL, which was substantially greater than that of the euthyroid group (178.5 mg/dL).

According to correlation studies, there was a statistically significant negative connection between triglyceride levels and both Free T3 and Free T4 ($r = -0.321$, $p = 0.001$ and $r = -0.278$, $p = 0.005$, respectively). On the other hand, triglyceride levels and TSH levels had a positive correlation ($r = 0.346$, $p < 0.001$). These results imply that whereas higher TSH values (a sign of compromised thyroid function) lead to worsened lipid profiles, lower thyroid hormone levels—particularly in cases of subclinical hypothyroidism—are linked to raised triglycerides.

Even when controlling for potential confounders like BMI and length of diabetes, multiple linear regression analysis demonstrated that TSH, Free T3, and Free T4 were significant independent predictors of triglyceride levels. Triglyceride levels were not significantly impacted by the length of diabetes, while there was a borderline connection between BMI and triglyceride levels ($p = 0.056$). These findings highlight how thyroid function affects lipid regulation and bolster the need for thyroid monitoring in diabetic patients, especially those with inadequate lipid control.

Overall, the study shows that thyroid dysfunction and high triglyceride levels in T2DM patients are clearly and clinically related. The results emphasize that as part of comprehensive cardiovascular risk reduction measures, thyroid problems in diabetes individuals must be identified early and managed.

The connection between thyroid function and lipid metabolism in individuals with type 2 diabetes has been the subject of several recent investigations. While thyroxine (T4) and thyroid-stimulating hormone (TSH) did not exhibit any significant correlations, a 2024 cross-sectional study of 150 T2DM patients revealed a significant negative correlation between plasma triiodothyronine (T3) levels and hepatic triglyceride content, indicating a protective metabolic role of T3 [11]. In a similar vein, a 2022 study conducted in Baghdad found that more than half of T2DM patients had thyroid dysfunction, which was characterized by elevated TSH and decreased T3 and T4 levels. Additionally, the patients' serum triglycerides, VLDL, and LDL levels were significantly higher than those of healthy controls [12].

Similar thyroid-lipid-glucose relationships may exist in pediatric diabetes, as evidenced by a 2021 pediatric study of children with T1DM that found lower FT3 and TSH levels in patients compared to controls. TSH was positively correlated with triglycerides, while FT3 was negatively correlated with triglycerides and fasting blood glucose [13]. These results were supported by another large cross-sectional investigation that showed FT3 was adversely correlated with triglyceride levels in children with T1DM, while greater TSH was strongly correlated with increased triglycerides [14].

A 2025 exploratory investigation on T2DM patients with hypothyroidism found significant changes in lipid profiles, including increased triglycerides, and observed that these abnormalities were more common in females, which further supports these relationships. The impact of thyroid dysfunction on lipid metabolism in diabetic people was further supported by the study's substantial associations between thyroid hormone levels and lipid markers [15].

A 2018 study highlighted that, according to receiver operating characteristic (ROC) curves, low FT3 and high TSH levels were independent predictors of diabetic nephropathy in patients with type 2 diabetes. Elevated triglyceride levels were also linked to these thyroid changes [16]. Triglycerides and HDL-C were considerably greater in T2DM patients with increased thyroid antibody levels (TGAb and TPOAb) and raised TSH, according to another 2023 study. This suggests that autoimmune thyroid disorders may exacerbate lipid profiles in diabetics [17].
According to a 2021 case-control study, TSH had a positive link with total cholesterol, LDL-C, and triglycerides, whereas T3 and T4 had negative relationships with these lipid markers, and T2DM patients had significantly lower T3 and T4 and higher TSH levels than controls [18].

Conclusion

Triglyceride levels and thyroid hormone levels in T2DM patients were found to be significantly correlated in this investigation. Thyroid hormones were independent predictors of lipid levels, and subclinical hypothyroidism was associated with elevated triglyceride levels. These results imply that regular thyroid function testing could help T2DM patients manage their dyslipidemia and lower their risk of cardiovascular disease.

References

1. American Diabetes Correlation. Standards of medical care in diabetes—2024. Diabetes Care. 2024;47(Suppl 1):S1–S300.
2. Grundy SM. Metabolic syndrome update. Trends Cardiovasc Med. 2020;30(2):120–124.
3. Mullur R, Liu YY, Brent GA. Thyroid hormone regulation of metabolism. Physiol Rev. 2021;101(2):389–425.

4. Biondi B. Thyroid and obesity: an intriguing relationship. J Clin Endocrinol Metab. 2019;104(12):5473–5482.
5. Dimitriadis G, et al. Insulin action in hyperthyroidism: a focus on muscle and adipose tissue. Front Endocrinol. 2021;12:667058.
6. Duntas LH, Brenta G. The effect of thyroid disorders on lipid levels and metabolism. Med Clin North Am. 2021;105(6):1031–1044.
7. Pearce EN. Update in lipid alterations in subclinical hypothyroidism. J Clin Endocrinol Metab. 2019;104(8):3205–3210.
8. Cettour-Rose P, et al. Thyroid hormones and lipid metabolism: new insights. Curr Opin Clin Nutr Metab Care. 2020;23(4):243–249.
9. Wang C, et al. Prevalence and clinical correlation of thyroid dysfunction in patients with T2DM. BMC Endocr Disord. 2020;20:133.
10. Althaus BU, et al. Thyroid hormones and lipid profiles in different populations: a meta-analysis. Horm Metab Res. 2019;51(2):105–112.
11. Kumar RR, Prakash J. Plasma Thyroid Hormone Concentration is Associated with Hepatic Triglyceride Content in Patients with Type 2 Diabetes. Int J Med Biomed Stud. 2024;8(3):12–17.
12. Kaduim AF. Disorders of Thyroid Hormones and Lipids in Patients with Type 2 Diabetes in Baghdad City. Pak J Med Health Sci. 2022;16(6):613–617.
13. Su H, Shan X, Lin K, Jiang H, Shi L. Correlation between serum thyroid hormones with glucose and lipid metabolism in children with type 1 diabetes. Chin J Diabetes. 2018;12(6):469–472.
14. Yuan C, Sun X, Liu Y, Wu J. The thyroid hormone levels and glucose and lipid metabolism in children with type 1 diabetes: a correlation analysis. Transl Pediatr. 2021;10(2):276–282.
15. Sharma S, Mathew D, Sharma AK, Singh SP, Sankhla V, Bhatia N, Sahi D. Glycaemic parameters, dyslipidaemia and thyroid hormone: an exploratory study of their interrelationship in Type 2 Diabetes Mellitus patients. J Neonatal Surg. 2025;14:23–29.
16. Fei X, Xing M, Wo M, Wang H, Yuan W, Huang Q. Thyroid stimulating hormone and free triiodothyronine are valuable predictors for diabetic nephropathy in patient with type 2 diabetes mellitus. Ann Transl Med. 2018;6(15):305–310.
17. Liu X, Qiu Y, Chen D, Xiong J, Xia B, Chen C, Li S. Significance of monitoring the levels of thyroid hormone antibodies and glucose and lipid metabolism antibodies in patients suffer from type 2 diabetes. Open Med (Wars). 2023;18:355–364.
18. P P. Correlation between thyroid hormones & lipid profile in type 2 diabetes mellitus patients: a case control study in tertiary care hospital. Int J Clin Biochem Res. 2021;8(1):25–28.