RESEARCH PAPER

Correlation Between Thyroid Hormone Levels And Lipid Profile In Hypothyroid Patients

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ABSTRACT
Background: Hypothyroidism is a common endocrine disorder that affects multiple metabolic processes, including lipid metabolism. Objective: To assess the correlation between thyroid hormone levels and lipid profile in hypothyroid patients. Methods: This cross-sectional analytical study was conducted at PNS Hafeez Islamabad from march 2025 to march 2026 included 189 diagnosed hypothyroid patients. Demographic and clinical data were recorded, including age, gender, BMI, residence, duration of hypothyroidism, and type of hypothyroidism. Thyroid function tests including TSH, FT3, and FT4 were measured along with fasting lipid profile including total cholesterol, triglycerides, LDL-C, and HDL-C. Results: The mean age of patients was 42.36 ± 11.28 years, and most patients were female 138 (73.0%). Overt hypothyroidism was present in 121 (64.0%) patients, while 68 (36.0%) had subclinical hypothyroidism. Mean TSH was 14.86 ± 8.74 mIU/L, FT3 was 2.41 ± 0.62 pg/mL, and FT4 was 0.83 ± 0.31 ng/dL. Mean total cholesterol was 219.68 ± 41.75 mg/dL, triglycerides were 181.34 ± 54.62 mg/dL, LDL-C was 143.27 ± 36.84 mg/dL, and HDL-C was 41.96 ± 9.18 mg/dL. Patients with overt hypothyroidism had significantly higher total cholesterol, triglycerides, and LDL-C, and lower HDL-C compared with subclinical hypothyroid patients ($p < 0.001$). Conclusion: Thyroid hormone levels were significantly correlated with lipid profile in hypothyroid patients. Higher TSH and lower FT3/FT4 levels were associated with a more atherogenic lipid profile.

Keywords: Hypothyroidism, TSH, FT3, FT4, lipid profile, dyslipidemia, cholesterol, LDL-C, HDL-C....
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INTRODUCTION

Hypothyroidism is one of the most common endocrine disorders and occurs due to deficient production or action of thyroid hormones [1]. It can manifest as a clinical hypothyroidism (high TSH and low free thyroxine [FT4]) or as a subclinical hypothyroidism (high TSH and normal FT4) [2]. Thyroid hormones have a key role in the regulation of BMR, energy expenditure, carbohydrate metabolism and lipid homeostasis [3]. Thus, slight thyroid dysfunction has the potential to disrupt multiple metabolic pathways and can lead to clinically relevant alterations in lipid levels in the serum [4]. Thyroid function is well known to be linked to lipid metabolism. Thyroid hormones affect cholesterol synthesis in liver, intestinal absorption of cholesterol, activity of lipoprotien lipase, cholesterol clearance and LDL receptor expression [5]. In hypothyroidism, the decreased activity of the thyroid hormone leads to a decrease in the expression of LDL receptors and a decrease in the rate of LDL cholesterol removal from the blood. This may lead to high total cholesterol, LDL cholesterol, triglycerides, and sometimes HDL cholesterol [6]. Recent reviews have suggested that hypothyroidism is often linked to elevated TOTC, LDL-C, and triglycerides levels, thus it is seen as an important secondary cause of dyslipidaemia [7]. Clinically relevant dyslipidaemia in hypothyroid patients can lead to atherosclerosis and cardiovascular disease, which is why it is important [8]. Hypothyroidism can also lead to endothelial dysfunction, increase systemic vascular resistance, elevate blood pressure (diastolic), weight gain, and low grade inflammation, which can further increase cardiovascular risk [9]. Thus, the thyroid-lipid axis not only

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is a biochemical relationship but also has clinical consequences for screening, prevention, and therapy of cardiovascular disease in thyroid dysfunction patients [10]. The American Thyroid Association also points out that low levels of thyroid hormone are linked to high cholesterol and that increasing thyroid hormone can lead to a decrease in cholesterol levels [11].

There have been several reports of abnormal lipid profiles in hypothyroid patients with overt and latent hypothyroidism. The most common abnormalities are an increase in serum total cholesterol and LDL cholesterol, and, in many patients, an increase in triglyceride levels as well [12]. Patients with subclinical hypothyroidism may have early abnormalities in their lipids before they have a noticeable symptom [13]. The link between thyroid hormones and lipid metabolism was also highlighted in a study conducted in 2025 on "Thyroid dysfunction and serum lipid levels" which further reinforced the importance of considering lipid status in patients with thyroid disease [14]. The prevalence of metabolic disorders, cardiovascular diseases, obesity and sedentary lifestyle in Pakistan have made hypothyroidism and dyslipidemia both clinically relevant concerns in the country.Hypothyroidism and dyslipidaemia are both clinically relevant issues in Pakistan due to rise in prevalence of metabolic disorders, cardiovascular disease, obesity and sedentary lifestyle. Lipid abnormalities have also been reported in patients with thyroid dysfunction based on local studies. In a local study, dyslipidemia might be present in a significant number of patients with subclinical hypothyroidism [16] and a Pakistani study reported an alteration of lipid parameters in subclinical and clinical hypothyroidism [17]. The results emphasize the importance of getting local evidence to evaluate the relationship between thyroid hormone levels and lipid profile in hypothyroid patients. Both thyroid function tests and lipid profile tests are easy, readily available, and routine laboratory tests used in clinical practice. This joint interpretation can be helpful for them to learn more about the metabolic and cardiovascular risk profile of hypothyroid patients [17].

Objective

To assess the correlation between thyroid hormone levels and lipid profile in hypothyroid patients.

METHODOLOGY

This was a cross-sectional analytical study conducted at PNS Hafeez Islamabad from march 2025 to march 2026, including 189 diagnosed hypothyroid patients to evaluate the correlation between thyroid hormone levels and lipid profile.

Inclusion Criteria:

Patients aged 18 years and above, of either gender, diagnosed with hypothyroidism on the basis of thyroid function tests, were included in the study. Patients with available thyroid hormone levels including TSH, FT3, and FT4, along with fasting lipid profile including total cholesterol, triglycerides, HDL-C, and LDL-C, were enrolled after informed consent.

Exclusion Criteria:

Patients with known diabetes mellitus, chronic kidney disease, chronic liver disease, pregnancy, acute illness, malignancy, history of thyroid surgery, current use of lipid-lowering drugs, oral contraceptive pills, steroids, or drugs affecting thyroid function or lipid metabolism were excluded from the study. Patients with incomplete laboratory data or unwilling to participate were also excluded.

Data Collection

After approval from the institutional ethical review committee, patients fulfilling the selection criteria were enrolled from the outpatient department and medical wards. Written informed consent was obtained from all participants. Demographic details including age, gender, residence, body mass index, duration of hypothyroidism, and relevant clinical history were recorded on a structured proforma. Blood samples were collected under aseptic measures after overnight fasting. Thyroid function tests including TSH, FT3, and FT4 were recorded. Fasting lipid profile including total cholesterol, triglycerides, HDL-C, and LDL-C was also measured. Patients were categorized according to thyroid status as overt hypothyroidism or subclinical hypothyroidism where required. The relationship between thyroid hormone levels and lipid parameters was then assessed.

Data Analysis

Data were entered and analyzed using SPSS version 25. Quantitative variables such as age, BMI, TSH, FT3, FT4, total cholesterol, triglycerides, HDL-C, and LDL-C were presented as mean ± standard deviation. Qualitative variables such as gender, residence, and type of hypothyroidism were presented as frequency and percentage. Pearson correlation test was applied to assess the correlation between thyroid hormone levels and lipid profile when the data were normally distributed. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

The study included 189 hypothyroid patients with a mean age of 42.36 ± 11.28 years, mean BMI of 27.84 ± 4.19 kg/m², and mean disease duration of 18.72 ± 9.64 months. Most patients were female, 138 (73.0%), urban residents, 116 (61.4%), and had overt hypothyroidism, 121 (64.0%). Nearly half were overweight, 93 (49.2%), while 54 (28.6%) were obese.

Table 1. Baseline demographic and clinical characteristics of hypothyroid patients (N = 189)

Variable	n (%) / Mean ± SD
Age (years)	42.36 ± 11.28
BMI (kg/m²)	27.84 ± 4.19
Duration of hypothyroidism (months)	18.72 ± 9.64
Male	51 (27.0)
Female	138 (73.0)
Urban residence	116 (61.4)
Rural residence	73 (38.6)
Overt hypothyroidism	121 (64.0)
Subclinical hypothyroidism	68 (36.0)
Normal weight	42 (22.2)
Overweight	93 (49.2)

Obese	54 (28.6)

The mean TSH level was raised at 14.86 ± 8.74 mIU/L, while FT3 and FT4 levels were relatively low, with mean values of 2.41 ± 0.62 pg/mL and 0.83 ± 0.31 ng/dL, respectively. The lipid profile showed an overall dyslipidemic pattern, with mean total cholesterol of 219.68 ± 41.75 mg/dL, triglycerides of 181.34 ± 54.62 mg/dL, and LDL-C of 143.27 ± 36.84 mg/dL.

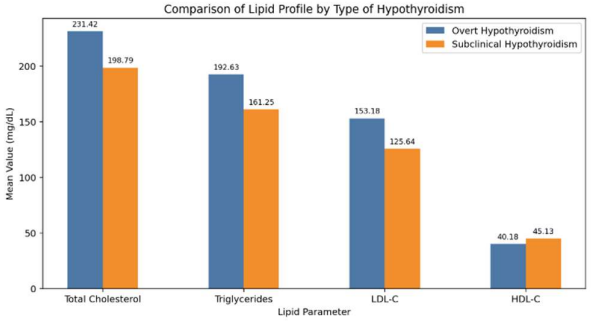
Table 2. Mean thyroid hormone levels and lipid profile among study participants (N = 189)

Parameter	Mean ± SD
TSH (mIU/L)	14.86 ± 8.74
FT3 (pg/mL)	2.41 ± 0.62
FT4 (ng/dL)	0.83 ± 0.31
Total cholesterol (mg/dL)	219.68 ± 41.75
Triglycerides (mg/dL)	181.34 ± 54.62
LDL-C (mg/dL)	143.27 ± 36.84
HDL-C (mg/dL)	41.96 ± 9.18

Overt hypothyroid patients had significantly higher total cholesterol, 231.42 ± 39.86 vs. 198.79 ± 35.72 mg/dL; triglycerides, 192.63 ± 56.41 vs. 161.25 ± 44.92 mg/dL; and LDL-C, 153.18 ± 34.59 vs. 125.64 ± 31.78 mg/dL, compared with subclinical patients. HDL-C was lower in overt cases, 40.18 ± 8.72 vs. 45.13 ± 9.12 mg/dL.

Table 3. Comparison of lipid profile between overt and subclinical hypothyroid patients

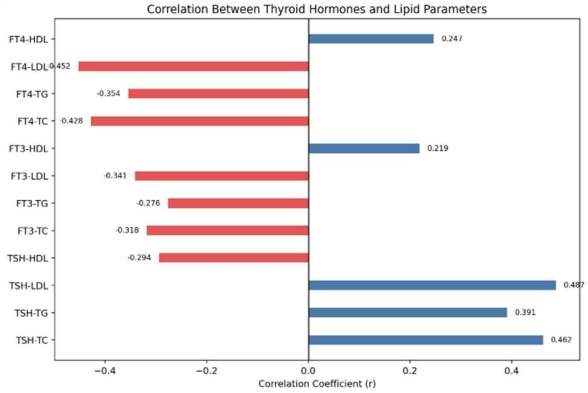
Lipid Parameter	Overt Hypothyroidism (n = 121)	Subclinical Hypothyroidism (n = 68)	p-value
Total cholesterol (mg/dL)	231.42 ± 39.86	198.79 ± 35.72	<0.001
Triglycerides (mg/dL)	192.63 ± 56.41	161.25 ± 44.92	<0.001
LDL-C (mg/dL)	153.18 ± 34.59	125.64 ± 31.78	<0.001
HDL-C (mg/dL)	40.18 ± 8.72	45.13 ± 9.12	<0.001



TSH was positively correlated with total cholesterol (r = 0.462), triglycerides (r = 0.391), and LDL-C (r = 0.487), but negatively with HDL-C (r = -0.294), all p < 0.001. FT3 and FT4 showed opposite trends, being negatively correlated with total cholesterol, triglycerides, and LDL-C, and positively correlated with HDL-C, indicating worse lipid abnormalities with greater thyroid dysfunction.

Table 4. Correlation between thyroid hormone levels and lipid profile

Thyroid Parameter	Lipid Parameter	Correlation Coefficient (r)	p-value
TSH	Total cholesterol	0.462	<0.001
TSH	Triglycerides	0.391	<0.001
TSH	LDL-C	0.487	<0.001
TSH	HDL-C	-0.294	<0.001
FT3	Total cholesterol	-0.318	<0.001
FT3	Triglycerides	-0.276	<0.001
FT3	LDL-C	-0.341	<0.001
FT3	HDL-C	0.219	0.002
FT4	Total cholesterol	-0.428	<0.001
FT4	Triglycerides	-0.354	<0.001
FT4	LDL-C	-0.452	<0.001
FT4	HDL-C	0.247	0.001



DISCUSSION

In the present study, we assessed the association between thyroid hormone level and lipid profile in 189 patients with hypothyroidism. The results indicated that there was a definite correlation between the progressive thyroid dysfunction and the more atherogenic lipid profile. The overwhelming majority of patients were female and overt hypothyroidism was more prevalent than subclinical hypothyroidism. The mean lipid values revealed that the total cholesterol, triglycerides and LDL-C values were high, whereas HDL-C value was comparatively low. This trend corroborates the well-documented relationship between hypothyroidism and dyslipidaemia and cardiovascular risk [18]. Total cholesterol, triglycerides and LDL-C were significantly higher in patients with overt as compared to patients with subclinical hypothyroidism in this study. Mean total cholesterol was 231.42 ± 39.86 mg/dL in overt hypothyroidism compared with 198.79 ± 35.72 mg/dL in subclinical hypothyroidism, while LDL-C was also higher in overt cases (153.18 ± 34.59 mg/dL vs. 125.64 ± 31.78 mg/dL). The mean level of HDL-C was significantly lower in patients with overt hypothyroidism. This indicates that

the lipid pattern was worse in more severe thyroid hormone deficiency. This was consistent with the results of earlier studies in which hypothyroidism was consistently linked to elevated total cholesterol, LDL-C, and triglyceride levels, which are a result of decreased hepatic LDL receptor activity and impaired lipid clearance [19]. Dyslipidemia was common in the present study with 158 patients (83.6%). Raised LDL-C level was the most common abnormality (132 patients, 69.8%), followed by raised total cholesterol (124 patients, 65.6%) and raised triglycerides (109 patients, 57.7%). Clinically relevant since LDL-C is one of the prominent atherogenic lipid fractions and is central to atherosclerosis development. A study based in Pakistan also revealed that there is a substantial number of patients with thyroid dysfunction who also have dyslipidaemia indicating the importance of lipid measurement in local hypothyroid patients [20]. Correlation analysis was performed and level of TSH was positively correlated with total cholesterol, triglycerides and LDL-C and negatively correlated with HDL-C. The highest positive correlation was found between TSH and LDL-C ($r = 0.487$, $p < 0.001$), while total cholesterol was the next strongest positive correlation with TSH ($r = 0.462$, $p < 0.001$). This suggests that the atherogenic lipid parameters were also influenced in the similar direction of increase in TSH. The results of the present study corroborate the findings of another recent study that found significant positive correlations between TSH and LDL-C and total cholesterol levels in patients with hypothyroidism [21].

FT3 and FT4 had an inverse relationship. Both hormones negatively correlated with the total cholesterol level, triglycerides and LDL-C level, and positively correlated with HDL-C level. This is a plausible finding, due to the biological activity of thyroid hormones, which stimulate lipid metabolism through greater expression of LDL receptor, better clearance of cholesterol, and increased activity of lipoprotein lipase. Thyroid hormones have been previously reviewed as regulators of lipid clearance and metabolism, and thyroid hormone deficiency leads to dyslipidemia, which is why the decrease in thyroid hormone levels slows lipid clearance [2]. The dose-response relationship between thyroid dysfunction and lipid abnormality is further confirmed by comparison of overt with subclinical hypothyroidism. Subclinical hypothyroidism did not have as severe a lipid derangement; however, lipid values were not entirely normal in many patients. This would indicate that even slight thyroid function abnormalities could be associated with early metabolic changes. Several studies have reported that there are lipid abnormalities in subclinical hypothyroidism, while other studies have shown inconsistent results, suggesting a possible influence of the level of TSH, age, BMI, sex and other metabolic risk factors on the lipid effects of subclinical disease.

Limitations

This study had several limitations. First, it was conducted as a cross-sectional study, so a causal relationship between thyroid hormone levels and lipid abnormalities could not be established. Second, the study was based on a single-center sample of 189 patients, which may limit the generalizability of the findings to the wider population. Third, factors such as dietary habits, physical activity, obesity duration, family history of dyslipidemia, and socioeconomic status were not assessed in detail, although they may influence lipid levels. In addition, thyroid treatment status, duration of treatment, and treatment compliance were not fully evaluated, which may have affected thyroid hormone and lipid profile values.

CONCLUSION

It is concluded that thyroid hormone levels were significantly correlated with lipid profile among hypothyroid patients. Higher TSH levels were associated with increased total cholesterol, triglycerides, and LDL-C, while HDL-C showed a negative correlation with TSH. In contrast, FT3 and FT4 showed negative correlations with atherogenic lipid parameters and positive correlations with HDL-C. Patients with overt hypothyroidism..

REFERENCE

1. Jakubiak GK, Pawlas N, Lejawa M, Morawiecka-Pietrzak M, Zalejska-Fiolka J, Stanek A, Cieślar G. Relationship of thyroid volume and function with carotid and femoral intima-media thickness in euthyroid people aged 18–65 taking into account the impact of diabetes, hypertension, and excess body mass. J Clin Med. 2025;14(2):604.

2. Ghaseminejad-Raeini A, Azarboo A, Zareshahi N, Jalali S, Fallahtafti P, Homaei A, et al. Early-life famine exposure and risk of osteoporosis and low bone mineral density: a systematic review and meta-analysis. Osteoporos Int. 2025;36(1):21-34.

3. Shirinezhad A, Eshlaghi FM, Salabat D, Azarboo A, Ardakani ZF, Esmaeili S, et al. Prevalent osteoporosis and fracture risk in patients with hepatic cirrhosis: a systematic review and meta-analysis. BMC Gastroenterol. 2025;25(1):115.

4. Jakubiak GK, Pawlas N, Morawiecka-Pietrzak M, Starzak M, Stanek A, Cieślar G. Retrospective cross-sectional study of the relationship of thyroid volume and function with anthropometric measurements, body composition analysis parameters, and the diagnosis of metabolic syndrome in euthyroid people aged 18–65. Medicina. 2024;60(7):1080.

5. Jakubiak GK, Pawlas N, Morawiecka-Pietrzak M, Zalejska-Fiolka J, Stanek A, Cieślar G. Relationship of thyroid volume and function with ankle-brachial index, toe-brachial index, and toe pressure in euthyroid people aged 18–65. Medicina. 2024;60(9):1445.

6. Chauhan A, Patel SS. Thyroid hormone and diabetes mellitus interplay: making management of comorbid disorders complicated. Horm Metab Res. 2024.

7. Shahid MA. Physiology, thyroid hormone. In: StatPearls. Treasure Island, FL: StatPearls Publishing;

2023.
8. Allen E, Fingeret A. Anatomy, head and neck, thyroid. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023.
9. Armstrong M. Physiology, thyroid function. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023.
10. Mathew P, Rawla P. Hyperthyroidism. In: StatPearls. Treasure Island, FL: StatPearls Publishing; 2023.
11. Jansen HI, et al. Hypothyroidism: the difficulty in attributing symptoms to their underlying cause. Front Endocrinol. 2023;14:1130661.
12. Bodke H, Wagh V, Kakar G. Diabetes mellitus and prevalence of other comorbid conditions: a systematic review. Cureus. 2023;15(11).
13. Kautzky-Willer A, Leutner M, Harreiter J. Sex differences in type 2 diabetes. Diabetologia. 2023;66(6):986-1002.
14. Hiasat DA, et al. The prevalence of diabetes distress among patients with type 2 diabetes in Jordan. J Taibah Univ Med Sci. 2023;18(6):1237.
15. Liao CJ, et al. Effects of thyroid hormones on lipid metabolism pathologies in non-alcoholic fatty liver disease. Biomedicines. 2022;10(6):12797.
16. Jiang H, Wang L, Wang D, Yan N, Li C, Wu M, Wang F, Mi B, Chen F, Jia W. Omega-3 polyunsaturated fatty acid biomarkers and risk of type 2 diabetes, cardiovascular disease, cancer, and mortality. Clin Nutr. 2022;41(8):1798-1807.
17. Liu Y, Li Y, Shen H, Li Y, Xu Y, Zhou M, Xia X, Shi B. Association between the metabolic profile of serum fatty acids and diabetic nephropathy: a study conducted in Northeastern China. Ther Adv Endocrinol Metab. 2022;13:20420188221118750.
18. Zhou G, Xu Y, Zhai Y, Gong Z, Xu K, Wang G, Sun C, Ma C. The association between serum palmitic acid and thyroid function. Front Endocrinol. 2022;13:860634.
19. Gu Y, Wu X, Zhang Q, Liu L, Meng G, Wu H, Zhang S, Wang Y, Zhang T, Wang X, et al. High-normal thyroid function predicts incident nonalcoholic fatty liver disease among middle-aged and older euthyroid subjects. J Gerontol A Biol Sci Med Sci. 2022;77(1):197-203.
20. Wang X, Jiang F, Chen W, Yuan H, Li Y. The association between circulating trans fatty acids and thyroid function measures in U.S. adults. Front Endocrinol. 2022;13:928730.
21. Li Y, et al. Evaluation of the thyroid characteristics and correlated factors in hospitalized patients with newly diagnosed type 2 diabetes. Diabetes Metab Syndr Obes. 2022:873-884.