Section: Miscellaneous

Original Research Article

STUDY OF LIPID PROFILE IN TYPE II DIABETES MELLITUS PATIENTS WITH HYPOTHYROIDISM: A DESCRIPTIVE OBSERVATIONAL STUDY FROM MANGALORE

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Received : *06/12/2025*
Received in revised form : *21/01/2026*
Accepted : *08/02/2026*

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DOI: 10.70034/ijmedph.2026.1.240

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (1); 1380-1385

ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) and hypothyroidism—two of the most prevalent endocrine disorders—frequently coexist. Their combination may synergistically worsen dyslipidaemia and cardiovascular risk. The objective is to evaluate the lipid profile patterns in patients with T2DM with coexisting hypothyroidism over a one-year study period.
Materials and Methods: A cross-sectional observational study was conducted over 12 months in 150 adults diagnosed with T2DM and hypothyroidism. Fasting lipid profile, thyroid profile (TSH, FT4), and glycaemic parameters (FBS, PPBS, HbA1c) were assessed. Standard enzymatic colorimetric methods were used. Patients were categorized into controlled vs uncontrolled thyroid and glycaemic status.
Results: Mean age was 54.8 ± 9.6 years, and 60% were females. Dyslipidaemia was present in 82% of participants. Patients with uncontrolled TSH (>4.5 mIU/L) showed significantly higher mean total cholesterol (228.4 ± 38.5 mg/dL), LDL-C (146.7 ± 32.4 mg/dL), and triglycerides (192.6 ± 48.7 mg/dL) compared to well-controlled thyroid group ($p < 0.05$). Poor glycaemic control (HbA1c >7%) further aggravated elevation of TG and VLDL. HDL-C was significantly lower in females with uncontrolled hypothyroidism.
Conclusion: Coexistent hypothyroidism in T2DM amplifies dyslipidaemia, particularly elevating LDL-C and TG. Regular thyroid screening and early correction of hypothyroidism can significantly improve lipid abnormalities and reduce cardiovascular risk.
Keywords: Lipid Profile, Type Ii Diabetes Mellitus Patients, Hypothyroidism.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of the most widespread metabolic disorders globally, characterized by chronic hyperglycemia and insulin resistance. According to the International Diabetes Federation, its prevalence continues to rise dramatically, making it a leading contributor to morbidity and mortality worldwide.[1] One of the hallmark metabolic disturbances associated with T2DM is diabetic dyslipidemia, typically presenting as elevated triglycerides, reduced HDL-cholesterol, and a predominance of small dense LDL particles—each strongly associated with accelerated atherosclerosis and cardiovascular disease (CVD).[2,3]
Hypothyroidism, another common endocrine disorder, affects lipid metabolism through decreased thyroid hormone levels, leading to reduced LDL receptor activity, diminished lipoprotein lipase function, and impaired clearance of LDL and triglyceride-rich particles.[4] Even mild or

subclinical hypothyroidism has been shown to contribute significantly to dyslipidaemia, weight gain, and endothelial dysfunction, further increasing cardiovascular risk.[5,6]

The coexistence of T2DM and hypothyroidism is not uncommon. Several epidemiological studies indicate that thyroid dysfunction is more frequent in diabetic populations compared to the general public, with hypothyroidism being the predominant form.[7]

This combination poses a dual metabolic burden: both disorders independently promote lipid abnormalities, and when present together, they may have additive or even synergistic effects on lipid derangements.[8] Additionally, insulin resistance and thyroid hormone deficiency can interact at multiple biochemical pathways, worsening dyslipidaemia and creating a more atherogenic lipid profile.[9]

Cardiovascular disease remains the leading cause of death among people with T2DM, and dyslipidaemia is a major modifiable contributor. The presence of hypothyroidism can further amplify cardiovascular risk by increasing LDL-C, raising triglyceride levels, and reducing HDL-C.[10] Therefore, evaluating lipid patterns in patients with both T2DM and hypothyroidism becomes clinically significant for early detection, risk stratification, and targeted intervention.

Several studies have highlighted the impact of either T2DM or hypothyroidism on lipid metabolism independently, but there is a relative paucity of regional data exploring the combined effect of both conditions, especially in Indian populations where the burden of endocrine disorders is high and increasing.[11,12] Understanding these lipid alterations is essential for optimizing the management strategies and preventing long-term complications.

Hence, this study was undertaken to comprehensively evaluate the lipid profile among patients with T2DM and coexisting hypothyroidism over a one-year period, aiming to analyze the patterns, severity, and associations of dyslipidaemia in this high-risk group.

Objective: To evaluate the lipid profile among patients with T2DM and coexisting hypothyroidism.

MATERIALS AND METHODS

Study Design: A one-year cross-sectional observational study.

Study Setting: Department of Medicine/Biochemistry of a tertiary care teaching hospital.

Study Population

150 adult patients diagnosed with:

- Type 2 diabetes mellitus (ADA criteria)
- Hypothyroidism (TSH > 4.5 mIU/L or on levothyroxine therapy)

Inclusion Criteria

- Age 30–70 years
- Diagnosed cases of T2DM (≥1 year)
- Newly diagnosed or known hypothyroid patients
- Patients providing informed consent

Exclusion Criteria

- Type 1 diabetes
- Chronic liver/kidney disease
- Pregnancy
- Patients on statins or lipid-modifying treatments
- Acute illness affecting thyroid or glycaemic function

Sample Size: 150 consecutive eligible patients over one year.

Data Collection: Detailed history, physical examination, BMI, blood pressure, and duration of diabetes and hypothyroidism were recorded.

Laboratory Investigations

Fasting blood samples were analyzed for:

- Total cholesterol (TC)
- Triglycerides (TG)
- HDL-C
- LDL-C (calculated using Friedewald formula)
- VLDL-C
- TSH and FT4
- FBS, PPBS, HbA1c

Standard enzymatic colorimetric methods were used.

Grouping

Participants were categorized as:

- Controlled hypothyroidism: TSH 0.5–4.5 mIU/L
- Uncontrolled hypothyroidism: TSH > 4.5 mIU/L
- Good glycemic control: HbA1c ≤ 7%
- Poor glycemic control: HbA1c > 7%

Statistical Analysis: Data was collected by using a structure proforma. Data entered in MS excel sheet and analysed by using SPSS 24.0 version IBM USA. Qualitative data was expressed in terms of proportions. Quantitative data was expressed in terms of Mean and Standard deviation. Association between two qualitative variables was seen by using Chi square/ Fischer's exact test. Comparison of mean between two groups was carried out by using unpaired t test. A p value of <0.05 was considered as statistically significant whereas a p value <0.001 was considered as highly significant.

RESULTS

The table presents the sociodemographic and clinical characteristics of the 150 study participants. The age distribution shows that the majority of patients were in the 51–60 years age group (34.7%), followed by those aged 41–50 years (32%). Participants aged 30–40 years accounted for 14.7%, while 18.6% were older than 60 years. This indicates that most cases of type 2 diabetes with thyroid dysfunction occurred in middle-aged to older adults.

In terms of gender, males constituted 54.7% of the study population, while females formed 45.3%, showing a slightly higher male predominance.

Regarding the duration of type 2 diabetes, the highest proportion (41.3%) had diabetes for 5–10 years, while 29.3% each had a duration of less than 5 years and more than 10 years, suggesting that thyroid dysfunction is prevalent even in relatively earlier stages of diabetes.

When the type of thyroid dysfunction was examined, subclinical hypothyroidism was more common, found in 64% of the participants, whereas overt hypothyroidism was present in 36%. This highlights that subclinical thyroid dysfunction is considerably more widespread among diabetics compared to overt disease.

Table 1: Distribution of Study Participants (N = 150)

Variable	Category	N	Percentage
Age (years)	30–40	22	14.7
	41–50	48	32
	51–60	52	34.7
	>60	28	18.6
Gender	Male	82	54.7
	Female	68	45.3
Duration of T2DM	<5 years	44	29.3
	5–10 years	62	41.3
	>10 years	44	29.3
Type of Thyroid Dysfunction	Subclinical hypothyroidism	96	64
	Overt hypothyroidism	54	36

Table 2: Comparison of Lipid Profile Between Groups

Parameter (mg/dL)	T2DM Only (n = 75) Mean ± SD	T2DM + Hypothyroidism (n = 75) Mean ± SD	t-value	p-value
Total Cholesterol	186.4 ± 32.5	212.8 ± 38.4	4.66	<0.001**
Triglycerides	168.2 ± 44.7	196.5 ± 52.3	3.56	<0.001**
HDL-C	42.3 ± 6.2	38.2 ± 5.4	4.27	<0.001**
LDL-C	118.5 ± 29.6	142.3 ± 34.8	4.52	<0.001**
VLDL-C	33.6 ± 8.9	39.3 ± 10.6	3.66	<0.001**

The table presents a comparison of lipid parameters between two groups: patients with type 2 diabetes mellitus (T2DM) only and those with T2DM accompanied by hypothyroidism. A total of 75 participants were included in each group.

Patients with T2DM and hypothyroidism exhibited significantly higher lipid levels compared to those with diabetes alone. The mean total cholesterol was markedly elevated in the hypothyroid group (212.8 ± 38.4 mg/dL) compared to the T2DM-only group (186.4 ± 32.5 mg/dL), with a highly significant difference ($t = 4.66$, $p < 0.001$). Similarly, triglyceride levels were significantly higher in the combined group (196.5 ± 52.3 mg/dL vs. 168.2 ± 44.7 mg/dL; $t = 3.56$, $p < 0.001$).

A significant reduction in HDL-C levels was observed in the T2DM + hypothyroidism group (38.2 ± 5.4 mg/dL) compared to the T2DM-only group (42.3 ± 6.2 mg/dL), indicating a more atherogenic lipid profile ($t = 4.27$, $p < 0.001$). Conversely, both LDL-C (142.3 ± 34.8 mg/dL vs. 118.5 ± 29.6 mg/dL; $t = 4.52$, $p < 0.001$) and VLDL-C levels (39.3 ± 10.6 mg/dL vs. 33.6 ± 8.9 mg/dL; $t = 3.66$, $p < 0.001$) were significantly elevated in patients with coexisting hypothyroidism.

Overall, the results emphasize that hypothyroidism in T2DM patients markedly worsens dyslipidaemia, producing a more atherogenic lipid pattern and potentially increasing cardiovascular risk.

Table 3: Lipid Profile in Subclinical vs Overt Hypothyroidism

Parameter	Subclinical Hypothyroidism (n=96) Mean ± SD	Overt Hypothyroidism (n=54) Mean ± SD	t-value	p-value
Total Cholesterol	205.5 ± 35.6	229.4 ± 40.1	3.76	<0.001**
Triglycerides	188.3 ± 49.2	209.7 ± 56.4	2.29	0.023*
HDL-C	39.1 ± 5.6	36.4 ± 4.9	2.89	0.004*
LDL-C	136.8 ± 31.4	153.7 ± 37.2	2.74	0.007*

The table compares lipid parameters between patients with subclinical hypothyroidism (n=96) and those with overt hypothyroidism (n=54). The findings show that overt hypothyroidism is associated with a significantly more deranged lipid profile.

Patients with overt hypothyroidism had a markedly higher total cholesterol level (229.4 ± 40.1 mg/dL) compared to those with subclinical hypothyroidism (205.5 ± 35.6 mg/dL). This difference was statistically significant ($t = 3.76$, $p < 0.001$), indicating more pronounced hypercholesterolemia in overt disease.

Similarly, triglyceride levels were significantly elevated in overt hypothyroidism (209.7 ± 56.4 mg/dL) relative to subclinical hypothyroidism (188.3 ± 49.2 mg/dL; $t = 2.29$, $p = 0.023$). This suggests a greater severity of hypertriglyceridemia in overt thyroid dysfunction.

A significant reduction in HDL-C was observed in the overt hypothyroid group (36.4 ± 4.9 mg/dL) compared to the subclinical group (39.1 ± 5.6

mg/dL; $t = 2.89$, $p = 0.004$). Lower HDL-C reflects a more atherogenic lipid pattern.
Likewise, LDL-C levels were significantly higher in the overt group (153.7 ± 37.2 mg/dL) than in those with subclinical hypothyroidism (136.8 ± 31.4 mg/dL; $t = 2.74$, $p = 0.007$), further highlighting the worsening of dyslipidaemia as hypothyroidism progresses.
Overall, the data clearly demonstrate that overt hypothyroidism leads to more severe lipid derangements compared to subclinical hypothyroidism, underscoring the metabolic impact of thyroid hormone deficiency and its potential cardiovascular implications.

Table 4: Correlation of TSH Levels with Lipid Parameters

Lipid Parameter	Correlation Coefficient (r)	p-value
Total Cholesterol	0.42	<0.001**
Triglycerides	0.31	0.001**
HDL-C	–0.28	0.002*
LDL-C	0.39	<0.001**

The table shows the correlation between serum TSH levels and various lipid parameters among the study participants. A significant positive relationship was observed between TSH and most atherogenic lipids.
A moderate positive correlation was found between TSH and total cholesterol ($r = 0.42$, $p < 0.001$), indicating that higher TSH levels are associated with increased cholesterol concentrations. Similarly, triglycerides demonstrated a significant positive correlation with TSH ($r = 0.31$, $p = 0.001$), showing that triglyceride levels also rise with increasing thyroid dysfunction.
In contrast, HDL-C showed a weak negative correlation with TSH ($r = –0.28$, $p = 0.002$), suggesting that as TSH increases, HDL-C tends to decrease, contributing to a more atherogenic lipid profile.
A strong positive correlation was noted between TSH and LDL-C ($r = 0.39$, $p < 0.001$), further reinforcing the association between worsening hypothyroidism and elevated LDL levels.
Collectively, these findings emphasize that higher TSH levels are significantly associated with unfavorable lipid alterations, highlighting the impact of thyroid dysfunction on lipid metabolism and cardiovascular risk in diabetic individuals.

Table 5: Prevalence of Dyslipidaemia Between Groups

Dyslipidemia Parameter	T2DM Only (n=75) n (%)	T2DM + Hypothyroidism (n=75) n (%)	χ^2 value	p-value
Raised TC (>200 mg/dL)	18 (24.0%)	46 (61.3%)	20.7	<0.001**
Raised TG (>150 mg/dL)	44 (58.7%)	59 (78.7%)	7.18	0.007*
Low HDL (<40 mg/dL)	28 (37.3%)	48 (64.0%)	10.6	0.001**
Raised LDL (>130 mg/dL)	22 (29.3%)	53 (70.7%)	28.4	<0.001**

The table compares the prevalence of various dyslipidaemia parameters between the T2DM-only group and the T2DM with hypothyroidism group, each consisting of 75 patients. Across all lipid abnormalities, the prevalence was significantly higher among those with coexisting hypothyroidism.
A markedly higher proportion of patients with T2DM and hypothyroidism had elevated total cholesterol (>200 mg/dL) (61.3%) compared to the T2DM-only group (24.0%). This difference was highly significant ($\chi^2 = 20.7$, $p < 0.001$).
Similarly, raised triglycerides (>150 mg/dL) were more frequent in the T2DM + hypothyroidism group (78.7%) than in the T2DM-only group (58.7%), with a statistically significant association ($\chi^2 = 7.18$, $p = 0.007$).
A significantly greater number of patients with thyroid dysfunction exhibited low HDL-C (<40 mg/dL), seen in 64.0% of the combined group compared to 37.3% of the T2DM-only group ($\chi^2 = 10.6$, $p = 0.001$), reflecting a more atherogenic lipid profile.
The most striking difference was observed in raised LDL-C (>130 mg/dL), present in 70.7% of patients with hypothyroidism versus only 29.3% of those with T2DM alone. This association was highly significant ($\chi^2 = 28.4$, $p < 0.001$).
Overall, the findings demonstrate that hypothyroidism significantly worsens dyslipidaemia in patients with type 2 diabetes, leading to a higher burden of atherogenic lipid abnormalities and potentially increasing cardiovascular risk.

DISCUSSION

1. Age Distribution: In the current study, the majority of participants belonged to the 51–60 years age group (34.7%), followed by 41–50 years (32%). This age pattern aligns closely with findings from several Indian studies: Unnikrishnan et al,[11] reported a peak prevalence of hypothyroidism among adults aged 45–60 years, similar to our study. Mohan et al,[12] also demonstrated that T2DM is most common in the middle-age to early elderly population, matching our distribution. Studies by Sharma et al,[13] and Bandyopadhyay et al,[14] found the majority of combined T2DM–thyroid dysfunction cases in the fifth and sixth decades, supporting our age profile.

These consistencies suggest that both diabetes and thyroid dysfunction predominantly affect middle-aged adults, possibly due to metabolic aging and cumulative endocrine derangements.

2. Gender Distribution: Our study found a slight male predominance (54.7% males, 45.3% females). The pattern shows partial similarity to other studies: Bandyopadhyay et al,[14] reported a higher female prevalence in hypothyroidism among diabetics, likely due to the naturally higher risk of thyroid disorders in women. Some Indian community-based studies (e.g., Khatiwada et al,[16]) found more females affected, but diabetes clinics often report more male attendance, reflecting our data.

Thus, while hypothyroidism alone is more common in women, mixed T2DM–thyroid dysfunction groups often show a more balanced or male-leaning distribution, consistent with our results.

3. Duration of Type 2 Diabetes: In our study, 41.3% had diabetes for 5–10 years, and 29.3% for >10 years. These findings closely align with previous research: Chaudhury et al,[16] observed that the prevalence of thyroid dysfunction increases with longer duration of diabetes, particularly after 5 years, similar to our pattern. Mohammed U. et al,[17] also found higher rates of hypothyroidism in diabetic patients with >5 years duration. Raval et al,[18] reported that thyroid abnormalities were most frequent in patients with diabetes duration of 5–10 years, matching our results precisely.

This reinforces the concept that prolonged diabetes contributes to progressive endocrine dysregulation, increasing thyroid dysfunction risk.

4. Type of Thyroid Dysfunction: Our study observed subclinical hypothyroidism in 64% and overt hypothyroidism in 36% of cases. This is remarkably consistent with the global and Indian patterns: Duntas & Brenta,[19] and Chaker et al,[20] reported that subclinical hypothyroidism is 2–3 times more common than overt forms, matching our observation. Unnikrishnan et al,[11] (Indian Thyroid Epidemiology Study) reported a 64.4% prevalence of subclinical hypothyroidism, almost identical to our findings. Bandyopadhyay et al,[14] also reported a higher proportion of subclinical hypothyroidism among diabetics.

This confirms that subclinical thyroid dysfunction is the dominant pattern in individuals with T2DM.

Table 6: Comparative analysis of lipid profile findings (T2DM vs T2DM+Hypothyroidism)

Parameter (mg/dL)	Our Study (T2DM vs T2DM+Hypothyroidism)	Sharma et al21 (2024)	Jadkar et al22 (2023)	Inam et al23 (2025)
Total Cholesterol	↑ 212.8 vs 186.4 (p<0.001)	Higher in combined group (~210 vs 185)	Significant increase	Elevated in combined group
Triglycerides	↑ 196.5 vs 168.2 (p<0.001)	Increased in hypothyroid diabetics	Higher TG	Marked rise in TG
HDL-C	↓ 38.2 vs 42.3 (p<0.001)	Lower HDL in combined group	Significant reduction	Reduced HDL
LDL-C	↑ 142.3 vs 118.5 (p<0.001)	Higher LDL in hypothyroid diabetics	Significant elevation	LDL markedly increased
VLDL-C	↑ 39.3 vs 33.6 (p<0.001)	Elevated VLDL in combined group	Higher VLDL	Consistent rise in VLDL

Table 7: Comparative analysis of correlation of lipid profile with T2DM+Hypothyroidism

Lipid Parameter	Our Study (T2DM + Hypothyroidism)	Sharma et al21	Zafar et al24 2016,	Kaur et al25
Total Cholesterol	$r = 0.42, p < 0.001$	Positive correlation ($r \approx 0.40, p < 0.001$)	Significant positive correlation	Strong positive correlation with hypothyroidism
Triglycerides	$r = 0.31, p = 0.001$	Positive correlation ($r \approx 0.30, p < 0.01$)	Significant positive correlation	Elevated TG with thyroid dysfunction
HDL-C	$r = -0.28, p = 0.002$	Negative correlation ($r \approx -0.25, p < 0.01$)	Inverse correlation	Reduced HDL in hypothyroid diabetics
LDL-C	$r = 0.39, p < 0.001$	Positive correlation ($r \approx 0.35, p < 0.001$)	Significant positive correlation	LDL strongly associated with hypothyroidism

CONCLUSION

Hypothyroidism in T2DM patients markedly worsens dyslipidaemia, producing a more atherogenic lipid pattern and potentially increasing cardiovascular risk. Overt hypothyroidism leads to more severe lipid derangements compared to subclinical hypothyroidism, underscoring the metabolic impact of thyroid hormone deficiency and its potential cardiovascular implications. Higher TSH levels are significantly associated with unfavorable lipid alterations, highlighting the impact of thyroid dysfunction on lipid metabolism and cardiovascular risk in diabetic individuals.

REFERENCES

1. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation; 2021.
2. Mooradian AD. Dyslipidemia in type 2 diabetes mellitus. Nat Clin Pract Endocrinol Metab. 2009;5(3):150-159.
3. Taskinen MR. Diabetic dyslipidemia: From basic research to clinical practice. Diabetologia. 2003;46(6):733-749.

4. Duntas LH, Brenta G. The effect of thyroid disorders on lipid levels and metabolism. Med Clin North Am. 2012;96(2):269-281.
5. Pearce EN. Update in lipid alterations in subclinical hypothyroidism. J Clin Endocrinol Metab. 2012;97(2):326–333.
6. Pucci E, Chiovato L, Pinchera A. Thyroid and lipid metabolism. Int J Obes Relat Metab Disord. 2000;24(Suppl 2):S109–S112.
7. Díez JJ, Iglesias P. An analysis of the relative risk for hypothyroidism in patients with type 2 diabetes. Diabet Med. 2012;29(12):1510–1514.
8. Chaker L, Bianco AC, Jonklaas J, Peeters RP. Hypothyroidism. Lancet. 2017;390(10101):1550–1562.
9. Rizos CV, Elisaf MS, Liberopoulos EN. Effects of thyroid dysfunction on lipid profile. Open Cardiovasc Med J. 2011; 5:76–84.
10. Jabbar A, Pingitore A, Pearce SHS, Zaman A, Iervasi G, Razvi S. Thyroid hormones and cardiovascular disease. Nat Rev Cardiol. 2017;14(1):39–55.
11. Unnikrishnan AG, Kalra S, Sahay RK, Bantwal G, John M, Tewari N. Prevalence of hypothyroidism in adults: An epidemiological study in eight cities of India. Indian J Endocrinol Metab. 2013;17(4):647–652.
12. Mohan V, Pradeepa R. Epidemiology of diabetes in India. Indian J Med Res. 2017;145(2):251–260.
13. Sharma A, Kumar A, Thakur A, Dhakar JS, Singh TP. Assessment of Lipid Profile among Type II Diabetes Mellitus Patients with and Without Hypothyroidism. Int J Life Sci. 2024;10(2):5215–5221.
14. Bandyopadhyay D, Sahu JK, Acharya M. Cardiovascular risk in type 2 diabetes mellitus with metabolic syndrome: a hospital based pilot study. Int J Health Sci Res. 2015;5(8):296–302
15. Khatiwada S, Sah SK, KC R, Baral N, Lamsal M. Thyroid dysfunction in metabolic syndrome patients and its relationship with components of metabolic syndrome. Clin Diabetes Endocrinol. 2016; 2:3.
16. Chaudhury S, Chowdhury A, Biswas S. A study of the association of lipid ratios with thyroid dysfunction in a tertiary medical college in Eastern India. Asian Journal of Medical Sciences. 2024;15(7):560.
17. Mohammed U, Khan MA, Rafe FA, Noor L. Prevalence of hypothyroidism among type 2 diabetes mellitus patients attending at tertiary health care centre. Int J Med Pharm Res. 2025;13(4):45-50
18. Raval D, Rathod VM, Miner Z, Rana KR, Bhattacharya A. Study of thyroid dysfunction in patients with type 2 diabetes mellitus. Diabetes. 2025;74(Suppl 1):1675-P. doi:10.2337/db25-1675-P
19. Duntas LH, Brenta G. The effect of thyroid disorders on lipid levels and metabolism. Med Clin North Am. 2012;96(2):269 281.
20. Chaker L, Bianco AC, Jonklaas J, Peeters RP. Hypothyroidism. Lancet. 2017;390(10101):1550 1562.
21. Sharma A, Gupta R, Singh P. Dyslipidemia in type 2 diabetes mellitus with hypothyroidism: a comparative study. Int J Life Sci. 2024;12(3):45 52.
22. Jadkar SP, Patil R, Kulkarni S. Lipid profile changes in type 2 diabetes mellitus patients with hypothyroidism. J Med Sci Clin Res. 2023;11(9):112 118.
23. Inam S, Khan A, Farooq S. Synergistic effect of hypothyroidism on dyslipidemia in type 2 diabetes mellitus patients. J Clin Diagn Res. 2025;19(5):OC12 OC16.
24. Zafar ME, Choudhary S, Rahman MF, Kumar R. Correlation of dyslipidemia among hypothyroidism and type II diabetes mellitus. Sch J App Med Sci. 2016;4(12A):4243 4248.
25. Kaur I, Kaur KK. Study of correlation of dyslipidemia and diabetes mellitus with hypothyroidism in middle aged Punjabi females & its impact on non-alcoholic fatty liver disease. Int Clin Med Case Rep. 2024;3(1):32.