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Original Research Article

Association of Thyroid Hormones with Lipid Profile Abnormalities in Hypothyroidism

Panchal Akshay Gunvantbhai[1], Rifa Pirani[2], Malvika Brahmbhatt[3]

[1]MBBS, GMERS Medical College and Hospital, Gandhinagar, Gujarat, India
[2]MBBS, M K Shah Medical College and Research Center, Ahmedabad, Gujarat, India
[3]MBBS, Banas Medical College and Research Institute, Palanpur, Gujarat, India

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Corresponding Author: Malvika Brahmbhatt
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Abstract:

Background: Hypothyroidism is known to alter lipid metabolism, leading to dyslipidemia and increased cardiovascular risk. Thyroid hormones play a crucial role in regulating lipid synthesis and clearance. Evaluating lipid profile changes in hypothyroid patients is essential for early prevention of metabolic complications.

Methods: A cross-sectional study was conducted on 204 hypothyroid patients. Serum levels of TSH and lipid parameters, including triglycerides, cholesterol, HDL, LDL, and VLDL, were measured. Data were analyzed using Pearson's correlation to determine the relationship between TSH and lipid profile. Statistical significance was set at $p < 0.05$.

Results: The study revealed elevated mean values of triglycerides, cholesterol, LDL, and VLDL, with a moderate decrease in HDL among hypothyroid patients. A significant positive correlation was found between TSH and VLDL ($r = 0.261$, $p = 0.009$). Other lipid parameters showed a positive but non-significant correlation with TSH. These findings suggest altered lipid metabolism associated with thyroid dysfunction.

Conclusion: Hypothyroidism is significantly associated with dyslipidemia, particularly elevated VLDL levels, increasing cardiovascular risk.

Keywords: Hypothyroidism, Lipid Profile, TSH, Dyslipidemia, VLDL, Cardiovascular Risk.

Introduction

Hypothyroidism is one of the most frequently encountered endocrine disorders, resulting from insufficient secretion of thyroid hormones—triiodothyronine (T3) and thyroxine (T4). These hormones, produced by the thyroid gland situated in the anterior neck, play a vital role in regulating metabolism, growth, thermoregulation, and cardiovascular function. A deficiency in these hormones slows metabolic activity, leading to multiple physiological disturbances that adversely influence health and quality of life [1]. Among the geriatric population, the prevalence of hypothyroidism is notably high due to age-related decline in thyroid function, the coexistence of chronic illnesses, and a greater susceptibility to autoimmune thyroid diseases such as Hashimoto's thyroiditis. In older adults, symptoms often appear vague—fatigue, weight gain, cold intolerance, depression, and constipation—which are frequently mistaken for normal aging or other health conditions, delaying diagnosis and management [2,3].

Thyroid dysfunction exerts a profound influence on lipid metabolism. Thyroid hormones are pivotal regulators of lipid synthesis, absorption, and clearance, and their deficiency leads to alterations in serum lipid profiles that predispose individuals to dyslipidaemia [4]. This lipid imbalance significantly elevates cardiovascular risk, contributing to atherosclerosis, coronary artery disease, and stroke. In hypothyroid patients, lipid abnormalities are typically characterised by elevated total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglycerides, accompanied by variable changes in high-density lipoprotein cholesterol (HDL-C) and very-low-density lipoprotein cholesterol (VLDL-C). Mechanistically, this arises from reduced hepatic LDL receptor activity, diminished lipoprotein lipase function, and delayed cholesterol clearance, resulting in lipid accumulation and increased atherogenic potential [5].

Subclinical hypothyroidism, identified by elevated thyroid-stimulating hormone (TSH) levels with normal T3 and T4 concentrations, also exerts subtle but clinically relevant effects on lipid homeostasis. Even in its subclinical form, thyroid dysfunction is linked to higher total cholesterol and LDL-C concentrations, suggesting an increased

cardiovascular burden [6]. Given these metabolic implications, evaluating the association between thyroid hormone levels and lipid profile disturbances is essential for early identification of cardiovascular risk in hypothyroid individuals.

This study, conducted at a tertiary care hospital in India, aims to assess the association between thyroid hormone levels and lipid profile abnormalities in patients with hypothyroidism, particularly in the geriatric population. The specific objective is to determine correlations between TSH, T3, T4, and lipid parameters—including total cholesterol, triglycerides, HDL-C, LDL-C, and VLDL-C—to better understand the metabolic interplay between thyroid dysfunction and dyslipidaemia.

Methods

Study Design: This cross-sectional observational study was conducted in a tertiary care hospital in India on 204 patients for 1 year. Both inpatients and outpatients presenting with suspected thyroid dysfunction were included. Prior to enrolment, written informed consent was obtained from all participants. Each subject underwent a detailed clinical assessment along with relevant biochemical and radiological investigations to evaluate hypothyroidism and associated lipid abnormalities in the geriatric population.

Inclusion Criteria: Individuals aged 60 years and above diagnosed with hypothyroidism.

Exclusion Criteria: Individuals with advanced cardiac dysfunction, chronic kidney disease in advanced stages, decompensated liver disease, or any active malignancy.

Methodology: A detailed proforma was used to record demographic data, presenting complaints, medical and medication history, and lifestyle habits such as smoking or alcohol use. A history of thyroid hormone therapy or drugs influencing thyroid metabolism was also noted.

Investigations: After overnight fasting, venous blood samples were collected for biochemical analysis. Lipid parameters—including total cholesterol, triglycerides, HDL-C, LDL-C, and VLDL-C—were estimated using enzymatic methods. Thyroid profile testing, including serum TSH, T3, and T4, was performed to assess thyroid status and its association with lipid abnormalities.

Statistical Analysis: Data was analyzed using SPSS version 19 with continuous variables being expressed as mean ± standard deviation (SD), while categorical data were presented as frequencies and percentages. A p-value of <0.05 was considered statistically significant.

Results

The majority of participants were between 60 and 69 years of age (54.9%), followed by 33.3% in the 70–79 age group and 11.8% aged 80 years or above. Females constituted a larger proportion of the study population (59.8%) compared to males (40.2%), indicating a higher prevalence of hypothyroidism among women. Most participants were from urban areas (57.8%), while 42.2% resided in rural regions. Hypertension (45.1%) and diabetes mellitus (33.3%) were the most frequent comorbidities, with 15.7% having both conditions. Over half of the subjects (52%) had been diagnosed with hypothyroidism for 1–5 years, suggesting a chronic disease pattern in this cohort (Table 1).

Table 1: Demographic Profile of the Study Cohort (n = 204)

Parameter	Category	Frequency (n)	Percentage (%)
Age (years)	60–69	112	54.9
	70–79	68	33.3
	≥80	24	11.8
Gender	Male	82	40.2
	Female	122	59.8
Residence	Urban	118	57.8
	Rural	86	42.2
Comorbidities	Hypertension	92	45.1
	Diabetes Mellitus	68	33.3
	Both Hypertension and Diabetes	32	15.7
	None	12	5.9
Duration of Hypothyroidism	<1 year	58	28.4
	1–5 years	106	52.0
	>5 years	40	19.6

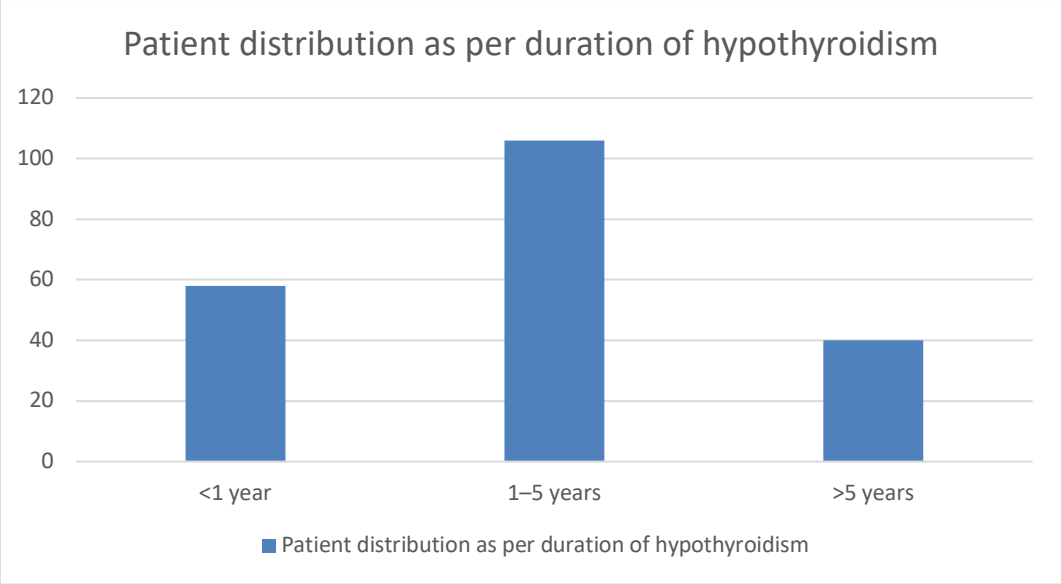

Figure 1: Patient distribution as per duration of hypothyroidism

The mean lipid profile levels among hypothyroid patients revealed a clear trend toward dyslipidaemia. The average triglyceride level was elevated (188.62 ± 46.21 mg/dL), and mean total cholesterol was moderately increased (176.54 ± 38.09 mg/dL). LDL-C and VLDL-C were also raised, with mean values of 86.38 ± 25.02 mg/dL and 36.10 ± 13.87 mg/dL, respectively. In contrast, the mean HDL-C level was relatively lower (54.12 ± 17.45 mg/dL). These findings indicate a lipid imbalance consistent with the atherogenic pattern often observed in hypothyroid individuals, particularly in elderly patients (Table 2).

Table 2: Mean Lipid Profile in Hypothyroidism (n = 204)

Parameter	Mean ± SD (mg/dL)
Triglycerides	188.62 ± 46.21
Total Cholesterol	176.54 ± 38.09
HDL-C	54.12 ± 17.45
LDL-C	86.38 ± 25.02
VLDL-C	36.10 ± 13.87

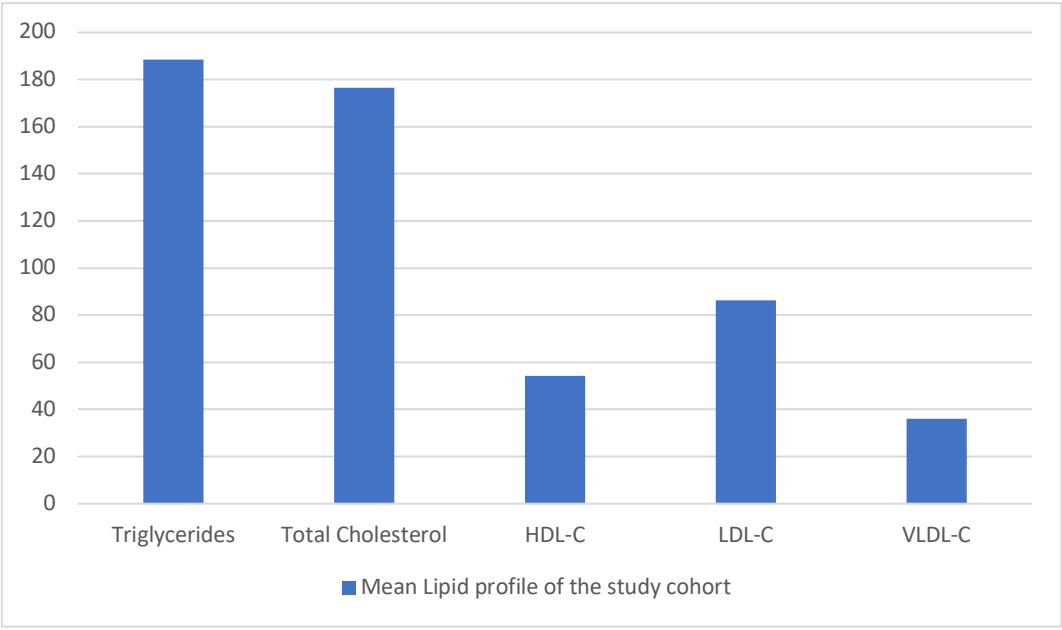

Figure 2: Mean Lipid Profile in patients with Hypothyroidism.

Correlation analysis demonstrated a positive association between TSH levels and several lipid parameters. A statistically significant correlation was observed between TSH and triglyceride levels, while a stronger and highly significant correlation was noted with VLDL-C. Although cholesterol, LDL-C, and HDL-C showed mild positive correlations with TSH, these associations were not statistically significant. Overall, the results suggest that increasing TSH levels, indicative of worsening hypothyroidism, are associated with elevated triglyceride and VLDL-C concentrations, underscoring the link between thyroid dysfunction and lipid metabolism abnormalities (Table 3).

Table 3: Correlation Between TSH Levels and Lipid Profile Parameters (n = 204)

Parameter	Correlation Coefficient (r)	p-value
Triglycerides	0.168	0.042*
Total Cholesterol	0.071	0.318
HDL-C	0.101	0.176
LDL-C	0.126	0.093
VLDL-C	0.284**	0.004**

Discussion

Dyslipidemia in hypothyroidism usually manifests as elevated total cholesterol, LDL-C, and triglyceride levels, while alterations in HDL-C and VLDL-C vary across studies [2,7,8]. The primary mechanisms responsible include reduced hepatic LDL receptor expression, decreased lipoprotein lipase activity, and impaired bile acid synthesis—all of which contribute to the accumulation of lipids and atherogenic dyslipidemia [9]. Understanding these metabolic disturbances is critical for managing the cardiovascular risks associated with hypothyroidism.

In the present study involving 204 hypothyroid patients, lipid profile analysis revealed a clear pattern of dyslipidemia consistent with findings from earlier research. The mean triglyceride level was 188.62 ± 46.21 mg/dL, total cholesterol 176.54 ± 38.09 mg/dL, HDL-C 54.12 ± 17.45 mg/dL, LDL-C 86.38 ± 25.02 mg/dL, and VLDL-C 36.10 ± 13.87 mg/dL, indicating significant lipid alterations among the study population. A statistically significant correlation was observed between TSH and VLDL-C, while a mild but non-significant positive relationship was noted with triglycerides ($r = 0.168$, $p = 0.042$). These findings suggest that increasing TSH levels are associated with elevated VLDL and triglyceride concentrations, indicating the contribution of thyroid dysfunction to atherogenic lipid changes. Similar patterns have been documented in earlier studies, where hypothyroid patients exhibited higher levels of triglycerides, total cholesterol, and LDL-C, with dyslipidemia reported in up to 90% of cases [10–16]. Furthermore, work by Jayasingh et al. and Meng et al. demonstrated that even subclinical hypothyroidism can cause lipid abnormalities, particularly affecting LDL-C and triglyceride levels [17,18].

The observed correlation between TSH and VLDL-C underscores the impact of thyroid dysfunction on lipid transport and metabolism. Since VLDL is a precursor to LDL and plays a key role in triglyceride transport, its elevation might contribute to metabolic syndrome and cardiovascular risk [19,20]. The clinical relevance of these findings highlights the necessity for routine lipid profile evaluation in hypothyroid patients. Early identification and management of dyslipidemia through lifestyle modification, dietary regulation, and pharmacological interventions such as statins can mitigate cardiovascular risk. Thyroid hormone replacement therapy, especially with levothyroxine, has been shown to improve lipid profiles by normalizing TSH and enhancing lipid clearance [21–23]. Future research should aim to elucidate the molecular pathways linking thyroid hormone deficiency to lipid dysregulation and explore therapeutic interventions that address both thyroid and lipid abnormalities for comprehensive cardiovascular risk reduction in hypothyroid patients.

Conclusion

This study demonstrates a clear association between thyroid dysfunction and lipid metabolism abnormalities in hypothyroid patients, particularly among the geriatric population. Elevated levels of total cholesterol, triglycerides, VLDL-C, and LDL-C observed in this study highlight the atherogenic lipid profile commonly linked with hypothyroidism. A significant positive correlation between TSH and VLDL-C further emphasizes the role of thyroid hormone imbalance in promoting dyslipidemia and increasing cardiovascular risk. These findings reinforce the importance of routine lipid profile evaluation in individuals with hypothyroidism to enable early identification and management of lipid abnormalities.

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