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Exploring Thyroid-Linked Dyslipidemia: A Study at a Tertiary Care Hospital in Karachi

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Abstract: *Dyslipidemia, an illness marked by elevated triglyceride and cholesterol levels, is frequently seen in thyroid disease patients. The disruption of lipid metabolism caused by both hypothyroidism and hyperthyroidism might result in imbalances that raise the risk of cardiovascular disease. By examining dyslipidemia frequency in patients with thyroid disease, this study aims to highlight the critical link between lipid control and thyroid function. By clarifying this connection, the study hopes to promote early detection and individualized care plans to lessen the impact of these related illnesses. At the Dr. Ruth K.M. Pfau Civil Hospital in Karachi, a descriptive cross-sectional study was carried out over a six-month period in the department of medicine. To check for lipid abnormalities, blood samples from qualified individuals were examined. With a mean age of 54.18 ± 8.41 years, the research discovered that 43.5% of patients had dyslipidemia. Of the 191 patients, 41.4% were female and 58.6% were male. The results highlight the high frequency of dyslipidemia in thyroid disease patients and the importance of early identification and treatment to avoid possible cardiovascular problems.*

Keywords: *Disorders, Dyslipidemia, Prevalence, Thyroid*

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Introduction

Abnormal thyroid function can have a significant effect on lipid metabolism and result in dyslipidemia, a disorder characterized by abnormal blood lipid concentrations [1]. This disturbance might show up as high triglyceride and/or cholesterol levels, which are important risk factors for heart disease. As vital modulators of lipid metabolism, thyroid hormones specifically, thyroxine (T4) and triiodothyronine (T3) manage a delicate equilibrium inside the body. This complicated process can be seriously disrupted by even little alterations in thyroid function, highlighting the deep relationship between lipid management and thyroid health [2,3].

Thyroid hormones are essential regulators of metabolic balance because they orchestrate the production, circulation, and breakdown of lipids. Serum cholesterol levels are often raised in both overt and subclinical hypothyroidism, mostly because of an increase in low-density lipoprotein (LDL) cholesterol, the so-called "bad cholesterol" that is linked to atherosclerosis and cardiovascular disease. High-density lipoprotein (HDL) cholesterol, also known as the "good cholesterol," on the other hand, tends to stay constant or even increase, indicating the intricate and specific way that thyroid hormones affect different lipid subtypes.

The beauty of endocrine control and its profound effects on cardiovascular health are highlighted by this complex interaction [4,5]. Serum cholesterol levels are frequently noticeably higher in hypothyroidism patients, mostly as a result of higher levels of the cholesterol-forming proteins low-density lipoprotein (LDL) and intermediate-density lipoprotein (IDL). Remarkably, this fat buildup happens in spite of decreased activity of the essential enzyme for synthesizing cholesterol, HMG-CoA reductase, underscoring the significant and contradictory effect of thyroid hormone shortage on lipid homeostasis [6].

Plasma cholesterol levels rise significantly when thyroid hormone production is inadequate, not because of increased synthesis but rather because of poor removal. Reduced bile cholesterol secretion, which leads to reduced fecal excretion, is the main cause of this disturbance. The liver's capacity to remove low-density lipoprotein (LDL) cholesterol from the circulation is hampered by a decrease in the number of hepatic LDL receptors. The significance of thyroid hormones in controlling lipid disposal pathways and maintaining metabolic balance is highlighted by this complex imbalance [7, 8].

Studies have shown a substantial correlation between thyroid problems and dyslipidemia, with prevalence rates ranging from 35% to more than 50%. Particularly, subclinical hypothyroidism is an often seen but sometimes unidentified influence on lipid problems [9, 10]. The significance of identifying distinct forms of thyroid dysfunction and regularly evaluating lipid profiles in those who

are impacted is highlighted by these findings. Considering the thyroid's critical function in controlling lipid metabolism, preventing cardiovascular risks requires early identification and focused treatment of dyslipidemia [11, 12]. Research on the frequency of dyslipidemia in people with thyroid problems is crucial since the thyroid plays a crucial role in controlling lipid metabolism. Significant lipid profile abnormalities can result from both hypo- and hyperthyroidism, increasing the likelihood of dyslipidemia and hence raising cardiovascular risks.

We conducted this study to investigate the prevalence of dyslipidemia in individuals with thyroid dysfunction because we firmly believe that this problem has to be addressed. With the help of the study's findings, medical practitioners will be able to better treat lipid imbalances and thyroid abnormalities by improving therapeutic techniques. These findings also have wider ramifications for public health campaigns and lay the groundwork for further studies targeted at reducing cardiovascular risks in thyroid disease populations.

Methodology

Study Design and Sampling Technique: The study design is a descriptive cross-sectional study, a non-probability, purposive sampling technique.

Sample Size and Study Duration: The sample size (n=191) was determined using the WHO sample size calculator. It was based on a 95% confidence level, a 7% margin of error, and a previously reported dyslipidemia prevalence of 41.5% among people with thyroid issues [13]. The duration of study was 6 months from February 12, 2024, to August 11, 2024, after the approval of the synopsis, and data were collected from Dr. Ruth K.M. Pfau Civil Hospital's Department of Medicine in Karachi.

Inclusion Criteria: The study focused on people between the ages of 20 and 70 who had been diagnosed with thyroid dysfunction for more than a year and who voluntarily gave their informed permission, using a non-probability sequential sampling approach.

Exclusion Criteria: The study did not include patients who were pregnant or nursing, had serious mental health conditions, had recently had thyroid surgery or radiation therapy, had a history of severe allergies, had cardiovascular disease, or had other serious endocrine disorders like diabetes mellitus that could complicate the relationship between lipids and thyroid function. Also excluded were those who had been on lipid-lowering medication for the previous three months or those who were hesitant to provide their permission.

Study Parameters: For the study purpose, four types of thyroid dysfunction were identified: subclinical hypothyroidism (elevated TSH levels > 5 mIU/L, low FT3 levels < 2.3 pg/ml, low FT4 levels < 0.89 ng/dl), hyperthyroidism (low TSH levels < 5 mIU/L, high FT3 levels > 4.2 pg/ml, high

FT4 levels > 1.76 ng/dl), hypothyroidism (elevated TSH levels > 5 mIU/L), and subclinical hyperthyroidism (low TSH levels < 5 mIU/L). Total cholesterol > 200 mg/dL or LDL levels ≥ 130 mg/dL were considered dyslipidemia.

Data Collection Procedure: The data was collected from the outpatient department. After thoroughly explaining the objective of the study that informed consent was obtained. The first part of the questionnaire includes important demographic information, such as height, weight, age, gender, and body mass index (BMI), which was carefully documented.

Using proven methods, BMI was computed. At the time of presentation, height was measured using a stadiometer and weight was recorded on a digital scale that was precisely calibrated. Using 3cc disposable syringes, blood samples were aseptically drawn and sent right away to the diagnostic lab for thorough lipid profile and dyslipidemia evaluation. Strict exclusion criteria were used to guarantee the accuracy and dependability of the results, successfully reducing confounding factors and enhancing the study's methodological soundness. Patients who had a history of hypertension, either managed or uncontrolled, and who had been taking antihypertensive drugs for at least six months were found to have hypertension. Those who had smoked for more than ten pack-years were deemed smokers, including those who had just stopped smoking and those who had quit within the previous six months.

Ethical Approval: Ethical approval was obtained from the College of Physicians and Surgeons, Pakistan (CPSP/REU/MED-2021-183-17569).

Statistical Analysis: With SPSS version 26.0, data were carefully input and examined. The Shapiro-Wilk test was utilized to evaluate the normality of continuous data. For important characteristics such as age, length of thyroid problems, height, weight, BMI, and TSH, T3, and T4 levels, descriptive statistics were computed, including mean ± standard deviation (SD). Types of thyroid diseases (i.e., hypothyroidism, hyperthyroidism, subclinical hypothyroidism, and subclinical hyperthyroidism), smoking history, gender, and the presence of dyslipidemia were among the categorical variables that were displayed as frequencies and percentages. The Chi-square test, with a significance threshold of 5%, was used for post-stratification analysis, and all statistical tests took into account a two-sided p-value. There was little possibility that the observed associations would have happened by chance, as shown by a p-value of less than 0.05, which was deemed statistically significant.

Results

Demographic and Clinical Characteristics

In order to determine the prevalence of dyslipidemia in people with thyroid problems, 191 participants in total were included in this study. There were 79 (41.4%) female participants and 112 (58.6%) male participants. 115 individuals (60.2%) had hypertension, 71 (37.2%) smoked, and 120 (62.8%) did not smoke. The Shapiro-Wilk test, which was used to assess the distribution of continuous data, verified that all variables were normal ($p > 0.05$).

The participants' average age was 54.18 ± 8.41 years (95% CI: 52.98–55.38). The average height and weight were 168.79 ± 8.58 cm (95% CI: 167.57–170.02) and 73.36 ± 10.29 kg (95% CI: 71.89–74.83), respectively. 25.82 ± 3.81 kg/m² was the mean body mass index (BMI) (95% CI: 25.28–26.37). The thyroid condition lasted 7.28 ± 3.21 years on average (95% CI: 6.82–7.74). The average TSH level was 3.65 ± 2.12 mIU/L (95% CI: 3.35–3.96), the average T3 level was 3.29 ± 0.50 pg/mL (95% CI: 3.21–3.36), and the average T4 level was 1.10 ± 0.41 ng/dL (95% CI: 1.04–1.16), (Table 1).

Table 1

Demographics and Clinical Characteristics

Variable	Mean ± SD	95% Confidence Interval	Normality Test (P-value)
Age (years)	54.18 ± 8.41	52.98 – 55.38	0.063
Weight (kg)	73.36 ± 10.29	71.89 – 74.83	0.078
Height (cm)	168.79 ± 8.58	167.57 – 170.02	0.101
BMI (kg/m²)	25.82 ± 3.81	25.28 – 26.37	0.085
Duration of thyroid disorder (years)	7.28 ± 3.21	6.82 – 7.74	0.093
TSH (mIU/L)	3.65 ± 2.12	3.35 – 3.96	0.112
T3 (pg/mL)	3.29 ± 0.50	3.21 – 3.36	0.100
T4 (ng/dL)	1.10 ± 0.41	1.04 – 1.16	0.285

Prevalence of Thyroid Disorders and Dyslipidemia

Thyroid disease subtypes were distributed as follows among the 191 participants in the study: 75 people (39.3%) had hypothyroidism, which was the most common, followed by 61 participants

(31.9%) who had subclinical hypothyroidism. There were 38 cases of hyperthyroidism (19.9%) and 17 cases of subclinical hyperthyroidism (8.9%). 83 people had dyslipidemia, which is noteworthy since it indicates a significant incidence of 43.5% in the study group (Table 2).

Table 2

Distribution of Thyroid Disorders and Dyslipidemia

Thyroid Disorder Type	**Prevalence (%)**
Hypothyroidism	39.3%
Hyperthyroidism	19.9%
Subclinical Hypothyroidism	31.9%
Subclinical Hyperthyroidism	8.9%
Overall Dyslipidemia	43.5%

Subgroup Analysis of Dyslipidemia Prevalence

Subgroup analyses were performed to investigate how dyslipidemia was distributed among different patient groups. 11.0% of participants aged 20–50 years and 32.5% of adults aged ≥50 years (about 65 participants) had dyslipidemia. The older cohort may have had a greater rate, according to these percentages, but the difference was not statistically significant (p=0.845).

Of the 79 females, 19.4% (15 females) had dyslipidemia, while 24.1% (27 males) of the 112 men had (p = 0.429). This suggests that the prevalence of dyslipidemia does not significantly differ by gender. Dyslipidemia was seen in 25.7% (n=49) of patients with thyroid disorders that lasted between two and seven years, and in 17.8% (n= 34) of those that lasted more than seven years (p = 0.462). Those with a shorter history of the condition have a slightly greater prevalence, but the difference was not statistically significant. Dyslipidemia was seen in 24.6% (about 28 patients) of hypertension patients (115 participants) and 18.8% (about 19 patients) of non-hypertensive people (76 participants) (p = 0.375). Despite being noticeable, this trend fell short of statistical significance.

In terms of BMI, the prevalence of dyslipidemia was 26.7% (n=30) among patients with a BMI between 20 and 26 kg/m² (about 114 participants), whereas it was 16.8% (n=14) among patients with a BMI beyond 26 kg/m² (about 77 participants) (p = 0.540). This outcome was not statistically significant, even though there seemed to be an adverse association. It's interesting to note that

dyslipidemia was more prevalent in non-smokers (n=120) at 27.2% (about 33 patients) than in smokers (n=71) at 16.2% (about 12 patients); nevertheless, this difference did not reach statistical significance (p = 0.965), (Table 3).

Table 3

Dyslipidemia Prevalence by Subgroups

Subgroup Comparison	**Dyslipidemia prevalence in Group 1**	**Dyslipidemia prevalence in Group 2**	**Observation**	**P-value**
Age Group	20–50 years: 11.0%	>50 years: 32.5%	Higher prevalence in >50 years	0.845
Gender	Males: 24.1%	Females: 19.4%	Higher in males	0.429
Disease Duration	2–7 years: 25.7%	>7 years: 17.8%	Slightly higher in 2–7 years	0.462
Hypertension Status	Hypertensive: 24.6%	Non-hypertensive: 18.8%	Higher among hypertensive	0.375
BMI Group	20–26 kg/m²: 26.7%	>26 kg/m²: 16.8%	Higher in normal-weight individuals	0.540
Smoking Status	Smokers: 16.2%	Non-smokers: 27.2%	Higher in non-smokers	0.965

To sum up, this study offers an intriguing look into the intricate connection between dyslipidemia and thyroid conditions. The results demonstrate the significant burden of lipid abnormalities in this patient population, with an overall dyslipidemia frequency of 43.5% among those with thyroid dysfunction (table 2). Although there were differences in the prevalence of dyslipidemia by age, gender, duration of the disease, BMI, smoking status, and hypertension status, none of these variables showed statistically significant relationships with the condition. These findings imply that although dyslipidemia is still a prevalent and worrisome comorbidity in thyroid diseases, the study's demographic and clinical variables may not have a significant impact on its prevalence.

Discussion

Thyroid issues are frequently linked to dyslipidemia, a metabolic condition characterized by elevated lipid levels, including triglycerides and cholesterol. Through the hormones T4 and T3, which affect cholesterol production and lipid metabolism, the thyroid gland controls metabolism. Hypothyroidism slows metabolism and raises lipid levels, especially LDL cholesterol, and is characterized by low thyroid hormone levels. On the other hand, hyperthyroidism increases metabolism and lowers cholesterol at first, but with time, it may cause other lipid profiles to become unstable [14, 15].

Thyroid dysfunction-related dyslipidemia dramatically increases the risk of cardiovascular conditions, such as atherosclerosis and problems from coronary arteries. The successful treatment of dyslipidemia in these individuals depends on a better comprehension of the intricate connection between thyroid hormones and lipid metabolism. Reducing cardiovascular morbidity and mortality in people with thyroid problems requires this kind of understanding [16, 17].

Our study's findings are in good alignment with earlier published statistics. Similar to our findings of 54.18 ± 8.41 years, another research, [18] found that the mean age of the patients was 51.08 ± 16.51 years. There was a modest male majority in both trials, with 58.6% of participants being male and 57.4% in that study. However, the length of disease varied significantly: our individuals had been living with thyroid diseases for an average of 7.28 ± 3.21 years, whereas their cohort had a mean duration of 2.06 ± 0.33 years. Although this difference existed, the prevalence of dyslipidemia was still rather similar 41.5% in their study vs 43.5% in ours highlighting a strong correlation between lipid abnormalities and thyroid dysfunction.

The results of a study [18] looked at the incidence of metabolic abnormalities in people with hypothyroidism in Egypt are quite similar to what we found. Similar to the demographic distribution shown in our study, the majority of their participants were female and they were mostly middle-aged and older persons. According to the study conducted in Egypt, 71.9% of patients with hypothyroidism had metabolic syndrome, with a significant percentage displaying central obesity, hypertriglyceridemia, raised fasting glucose, and decreased HDL cholesterol values. Although the prevalence of dyslipidemia in individuals with different thyroid diseases, including overt and subclinical kinds, was the primary focus of our investigation, the observed prevalence of dyslipidemia of 43.5% is consistent with the larger metabolic load that the Egyptian results showed.

These parallels highlight how lipid metabolic abnormalities and thyroid dysfunction are consistently linked in many groups. Additionally, the Egyptian study's link between increased TSH levels and metabolic problems emphasizes how crucial it is for patients with thyroid dysfunction to undergo attentive lipid and metabolic assessment. Compared to the results of the Nepalese study [17], found a considerably greater frequency of dyslipidemia among 276 patients (66.30%), our study found a prevalence of 43.5%. Given that the Nepalese study found a stronger correlation between dyslipidemia

and primary hypothyroidism (55.07%), followed by subclinical hypothyroidism (38.04%), one possible explanation for the disparity in prevalence rates is sample characteristics. However, our study exhibited a lower overall prevalence of dyslipidemia, even though it also included other thyroid dysfunctions.

While our study found no statistically significant differences in the prevalence of dyslipidemia across thyroid disorder types ($p > 0.05$), the study found significant associations between dyslipidemia and specific lipid components, including decreased HDL ($p = 0.009$), elevated triglycerides ($p = 0.02$), and non-HDL/HDL ratios ($p = 0.033$). This implies that the kind of thyroid condition may have a more noticeable effect on lipid profiles among the people of Nepal. Patients with hypothyroidism also had greater prevalence's of elevated triglycerides (10.1%) and reduced HDL (18.5%), which is consistent with the lipid abnormalities commonly linked to thyroid dysfunction, according to the Nepalese study.

Even while our study did not offer a comprehensive lipid profile analysis in the same manner, these findings are nevertheless in line with the overall patterns of dyslipidemia in individuals with thyroid disorders. Further research is required to understand how thyroid dysfunction types and demographic factors interact to influence lipid profiles across various populations, as this comparison highlights the possibility of regional variability in the relationship between thyroid disorders and lipid abnormalities.

Conclusion

Thyroid dysfunction and lipid abnormalities are significantly correlated, according to this study, which examined the frequency of dyslipidemia in individuals with thyroid diseases. The results demonstrated that a considerable percentage of people with thyroid problems also had dyslipidemia, highlighting the metabolic consequences of thyroid disorders. The therapeutic significance of regular cholesterol monitoring in thyroid patients is reaffirmed by this study in order to enable prompt intervention and lower the risk of cardiovascular problems.

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