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Pattern of Lipid Abnormalities in Newly Diagnosed Primary Hypothyroidism: A Cross-Sectional Study from Nowshera, Pakistan

Muhammad Usman, Mohammad Bilal, Tahir Hussain, Muhammad Khalid, Kalim Ullah Khan, Atif Ullah

Abstract

Objective: To evaluate the prevalence and pattern of lipid abnormalities among newly diagnosed primary hypothyroid patients presenting to a tertiary care center in Nowshera, Pakistan.

Study Design and Setting: Cross-sectional study conducted from October 2024 to May 2025 at the Department of Medicine, Qazi Hussain Ahmad Medical Complex, Nowshera, Pakistan.

Methodology: This study was conducted over a period of six months and included 109 newly diagnosed primary hypothyroid patients aged 18–70 years, recruited through non-probability consecutive sampling. Hypothyroidism was confirmed by elevated thyroid-stimulating hormone (TSH >4.5 mIU/L) and decreased free thyroxine (free T4 <0.8 ng/dL). Fasting lipid profiles were measured, and lipid abnormalities were defined according to Adult Treatment Panel III (ATP III) criteria.

Results: Among 109 patients (mean age 38.6 ± 11.2 years; 68.8% females; mean BMI 27.8 ± 4.6 kg/m²), 86.2% had at least one lipid abnormality. The most frequent lipid abnormality was hypertriglyceridemia (59.6%), followed by low HDL-C (55.0%) and elevated LDL-C (53.2%), while hypercholesterolemia was observed in 34.9% of patients. No statistically significant differences were observed across sex, age, or BMI categories ($p > 0.05$). BMI showed a positive correlation with total cholesterol ($r = 0.30$, $p = 0.002$) and triglycerides ($r = 0.48$, $p < 0.001$), and a negative correlation with HDL-C ($r = –0.21$, $p = 0.03$).

Conclusion: Dyslipidemia is highly prevalent in newly diagnosed hypothyroid patients, with hypertriglyceridemia and low HDL-C being the most common abnormalities. These findings highlight the importance of routine lipid screening and early cardiovascular risk management in patients with hypothyroidism.

Keywords: Dyslipidemia; Hypertriglyceridemia; Hypothyroidism; Lipid profile; Low HDL-C; Pakistan

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INTRODUCTION

Hypothyroidism is characterized by an inadequate production of thyroid hormones (thyroxine [T4] and triiodothyronine [T_3]) and a compensatory elevation of thyroid-stimulating hormone (TSH), is a common endocrine disorder worldwide.[1,2] The prevalence of overt and subclinical hypothyroidism in adults has been estimated to range from about 0.5 % to 5 % and 3 % to 10 %, respectively, depending on age, sex, and iodine status of the population.[3] Thyroid hormones exert broad effects on basal metabolic rate, cardiac function, and lipid and carbohydrate metabolism.[4]

One of the well-recognized consequences of hypothyroid states is the development of dyslipidemia, often termed "secondary dyslipidemia".[5] Thyroid hormones influence nearly every step of lipid metabolism: they upregulate hepatic LDL receptor gene expression, stimulate cholesterol synthesis via HMG-CoA reductase, modulate lipoprotein lipase and hepatic lipase activities, and regulate apolipoprotein expression and reverse cholesterol transport.[6] In overt hypothyroidism, reduced LDL receptor activity and decreased lipolytic enzyme activity tend to result in elevated total cholesterol (TC), increased low-density lipoprotein cholesterol (LDL-C), and often

hypertriglyceridemia, while changes in high-density lipoprotein cholesterol (HDL-C) are more variable.[7]

Although the association between hypothyroidism and abnormal lipid profiles is well established in overt disease, data are more heterogeneous in newly diagnosed and subclinical cases, especially in different ethnic and regional populations.[8] For instance, a 2023 study by Tarboush et al. found that LDL, TG, and total cholesterol levels were significantly higher in patients with overt and subclinical hypothyroidism compared to euthyroid controls, although HDL differences were not statistically significant.[9] Some studies, however, have reported weaker or no independent association after adjustment for confounders. Regional and hospital-based studies likewise reveal varying frequencies of hypercholesterolemia, elevated LDL, low HDL, and hypertriglyceridemia in hypothyroid patients.[10,11] Characterizing the pattern and frequency of specific lipid abnormalities (i.e. hypercholesterolemia, high LDL, low HDL, hypertriglyceridemia) in newly diagnosed hypothyroid patients has both scientific and clinical importance.[12] First, early recognition of dyslipidemia in thyroid disease can guide prompt risk stratification and cardiovascular risk mitigation. Second, it informs clinicians about whether a "universal screening" approach or a more targeted lipid evaluation is warranted in hypothyroid patients. Third, knowing the prevalent lipid derangements can help tailor lipid-lowering or thyroid replacement strategies in your patient population.[13]

In view of the scarcity of data from our region and institution, this study aim to contribute to the body of knowledge by identifying the prevalence of different lipid profile abnormalities among newly presenting cases of hypothyroid patients presented to our institution. This may then serve as a basis to aid the clinician in the early intervention and management of hypothyroid patients with co-existing lipid profile abnormalities.

METHODOLOGY

This cross-sectional study was conducted in the Department of Medicine, Qazi Hussain Ahmad Medical Complex, Nowshera, from October 2024 to May 2025. The study protocol was reviewed and approved by the Institutional Ethics Committee of Qazi Hussain Ahmad Medical Complex, Nowshera (Ref. No. 02/ERB/NMC; dated 08 October 2024). Written informed consent was obtained from all participants before enrollment. The confidentiality of participants' data was strictly maintained throughout the study. The sample size was calculated as 109 patients using the WHO sample size calculator. The calculation was based on an expected prevalence of hypercholesterolemia of 35% in hypothyroid patients[8], with 9% absolute precision and a 95% confidence level. Patients fulfilling the eligibility criteria were recruited by non-probability consecutive sampling until the sample size was reached.

Adults aged 18–70 years of either sex with *newly diagnosed primary hypothyroidism*. Newly diagnosed hypothyroidism was defined as (i) clinical symptoms suggestive of hypothyroidism (fatigue, weight gain, cold intolerance, constipation, etc.) and (ii) laboratory confirmation of elevated TSH (>4.5 mIU/L) with low free T4 (<0.8 ng/dL or <10 pmol/L), were included in the study. On the other hand patients with conditions or treatments that could affect lipid levels, including: established coronary artery disease, ischemic heart disease, diabetes mellitus, uncontrolled hypertension, pregnancy, or current use of drugs influencing thyroid or lipid metabolism (levothyroxine, amiodarone, corticosteroids, statins, or other lipid-lowering agents) were excluded from the study. After obtaining written informed consent, demographic details (age, sex, residence, education, socioeconomic status), clinical history, and anthropometric measurements (height, weight, BMI) were recorded on a structured proforma. Thyroid function tests (TSH and free T4) were performed to confirm eligibility. For the assessment of the lipid profile, 7 mL of venous blood samples were collected after an overnight fasting. These samples were analyzed in the hospital laboratory by employing standard enzymatic techniques on automated analyzers under the guidance of a consultant chemical pathologist. There were proper quality control mechanisms in place during the entire process. Definitions of abnormal lipid profiles were made in accordance with the guidelines of the Adult Treatment Panel III. An abnormal level of cholesterol in the blood was defined as levels above 240 mg/dL or 6.2 mmol/L. Similarly, abnormal levels of LDL-C were defined as =160 mg/dL or 4.1 mmol/L. Abnormal HDL-C levels were defined as those below 40 mg/dL in males and those below 50 mg/dL in females. Abnormal levels of triglycerides in the blood were defined as those between 200–499 mg/dL or 2.3–5.6 mmol/L. On the basis of the above definitions of abnormal lipid profiles, the lipid profile of each individual was classified as abnormal or normal.

IBM SPSS Statistics 25 software was used for the analysis of the collected data. For the continuous variables like age, BMI, lipid levels, the distribution of the data is checked to see whether the data is normally distributed or not. If the data is found to be normally distributed, the results will be shown in the form of mean ± SD. If the data is not normally distributed, the results will be shown in the form of median and interquartile range. Similarly, for the categorical variables like sex, the results will be shown in the form of frequencies and percentages. The primary outcome was the frequency of lipid profile abnormalities (high TC, high LDL-C, low HDL-C, high TG). Stratified analyses were performed by age group (<40 vs =40 years), sex, BMI category (normal, overweight, obese according to Asian criteria), and residential status (urban vs rural). Chi-square test (or Fisher's exact test when applicable) was used to assess associations, with $p < 0.05$ considered statistically significant. Results are

presented in tables and text.

RESULTS

A total of 109 patients with newly diagnosed primary hypothyroidism were enrolled. The mean age was 38.6 ± 11.2 years (range: 19–70 years), with 60% of participants between 30 and 50 years. Females predominated (n = 75, 68.8%), giving a female-to-male ratio of 2.2:1. The mean BMI was 27.8 ± 4.6 kg/m²; 30% were obese, 45% overweight, and 25% within the normal range according to Asian BMI criteria. Most patients resided in rural areas (55%) and 62% had attained at least secondary-level education. No statistically significant sex-based differences were observed in age or BMI ($p > 0.05$). Dyslipidemia was highly prevalent in this cohort. Overall, 94 patients (86.2%) had at least one lipid abnormality, while only 15 (13.8%) demonstrated a completely normal lipid profile. Hypertriglyceridemia was the most frequent abnormality (59.6%), followed by low HDL-C (55.0%), high LDL-C (53.2%), and hypercholesterolemia (34.9%). The mean serum lipid values were: Total cholesterol: 228 ± 46 mg/dL (64% >200 mg/dL; 35% >240 mg/dL), LDL-C: 148 ± 35 mg/dL (53.2% =160 mg/dL), HDL-C: 44 ± 11 mg/dL (42 ± 10 in men; 45 ± 11 in women); 55% below recommended cut-offs, Triglycerides: 218 ± 96 mg/dL (median 205, IQR 150–270); 15% >300 mg/dL; 2 cases >400 mg/dL. Hypertriglyceridemia was the most frequent abnormality, followed by low HDL-C, high LDL-C, and hypercholesterolemia. Among the 109 newly diagnosed hypothyroid patients, dyslipidemia was highly prevalent. Overall, 86.2% of patients demonstrated at least one lipid abnormality, while only 13.8% had a completely normal lipid profile. The most common lipid derangement was hypertriglyceridemia, which was noted in 59.6%, followed by low HDL-C levels in 55.0%, and high levels of LDL-C in 53.2%. Hypercholesterolemia was noted in 34.9% of the population. Figure 1 shows a bar chart that demonstrates the prevalence of lipid abnormalities among the population. This shows that hypertriglyceridemia and low HDL-C levels were the most common lipid abnormalities among the population. Using the continuous method of analysis, there was a significant but slight correlation between BMI and lipid levels. The percentage of dyslipidemia among the newly diagnosed hypothyroid patients was found to be 86%. The most common lipid abnormality was high triglyceride, accounting for 59.6%, followed by low HDL-C, accounting for 55.0%. High LADL-C was the third most common abnormality, accounting for 53.2%. A large percentage of the population had =2 abnormal lipid profiles. A slightly higher percentage of dyslipidemia was found among females, the elderly, and overweight/obese patients, though the results were not significant. BMI had a positive correlation with TC and TG, and negative correlation with HDL-C

Table 1. Baseline characteristics of study population (N = 109)

Variable	Value
Age (years)	38.6 ± 11.2 (range 19–70)
Age group: <30 / 30–50 / >50	20 (18.3%) / 65 (59.6%) / 24 (22.0%)
Sex (F/M)	75 (68.8%) / 34 (31.2%)
BMI (kg/m²)	27.8 ± 4.6
BMI category: Normal / Overweight / Obese	27 (24.8%) / 49 (45.0%) / 33 (30.3%)
Residence	Rural 60 (55.0%), Urban 49 (45.0%)
Socioeconomic status	Low 44 (40.4%), Middle 55 (50.5%), High 10 (9.2%)
Education = secondary	68 (62.4%)
TSH (mIU/L)	18.5 ± 9.7
TSH: 5–10 / >10	29 (26.6%) / 80 (73.4%)
Free T4 (ng/dL)	0.54 ± 0.15

Table 2. Frequency of lipid abnormalities in newly diagnosed hypothyroid patients (N = 109)

Lipid Parameter	Cut-off (ATP III)	Patients with Abnormal Level, n (%)
High total cholesterol	>240 mg/dL	38 (34.9%)
High LDL-C	=160 mg/dL	58 (53.2%)
Low HDL-C	<40 mg/dL (M), <50 mg/dL (F)	60 (55.0%)
High triglycerides	200–499 mg/dL	65 (59.6%)

Table 3. Stratified prevalence of lipid abnormalities by sex, age, and BMI

Subgroup	High TC (%)	High LDL (%)	Low HDL (%)	High TG (%)
Sex				
Male (n=34)	11 (32.4)	16 (47.1)	18 (52.9)	18 (52.9)
Female (n=75)	27 (36.0)	42 (56.0)	42 (56.0)	47 (62.7)
Age				
=40 years (n=55)	17 (30.9)	26 (47.3)	30 (54.5)	29 (52.7)
>40 years (n=54)	21 (38.9)	32 (59.3)	30 (55.6)	33 (61.1)
BMI				
<25 (n=27)	7 (25.9)	13 (48.1)	16 (59.3)	14 (51.9)
=25 (n=82)	31 (37.8)	45 (54.9)	44 (53.7)	51 (62.2)

p > 0.05 for all subgroup comparisons (Chi-square/Fisher's exact tests)

Figure 1. Prevalence of lipid abnormalities in newly diagnosed primary hypothyroid patients (N = 109).

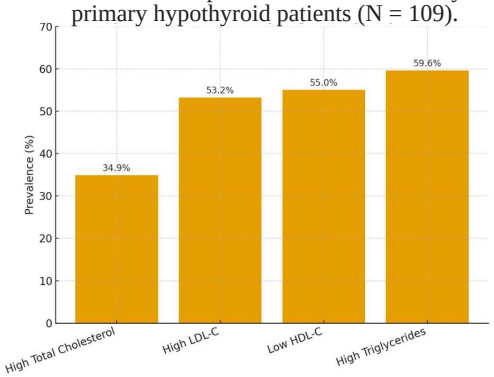

Table 4. Correlation of BMI with lipid levels

Lipid Parameter	Spearman r	p-value
Total cholesterol	+0.30	0.002
LDL-C	+0.18	0.06
HDL-C	–0.21	0.03
Triglycerides	+0.48	<0.001

DISCUSSION

In this cross-sectional study of 109 patients with newly diagnosed primary hypothyroidism, we observed a high prevalence of dyslipidemia. The most frequent lipid abnormality was hypertriglyceridemia (59.6%), followed closely by low HDL-C (55.0%) and high LDL-C (53.2%), while hypercholesterolemia was present in approximately one-third of patients (34.9%). Notably, over 86% of patients exhibited at least one lipid abnormality, highlighting the strong link between hypothyroidism and disturbed lipid metabolism.

Our findings are consistent with earlier studies reporting frequent lipid derangements in hypothyroid patients. Shams et al. described increased total cholesterol and LDL-C as classical biochemical features of overt hypothyroidism, attributable to reduced LDL receptor activity and impaired clearance of cholesterol-rich lipoproteins.[14] In our study, 53.2% of subjects were found to have high LDL levels, similar to the finding in a study done by Tarboush et al., where they found high levels of LDL in both overt and subclinical hypothyroidism.[15]

In this study, hypertriglyceridemia, the most common abnormality, was found in almost 60% of subjects.[16] Though this figure is slightly higher than in some Western studies, where hypertriglyceridemia is not a prominent abnormality, it is similar to some studies done in South Asian and Middle Eastern populations. Ethnic, dietary, and lifestyle differences may partly explain this discrepancy.[17]

In addition, low HDL-C levels were also common in our population (55%), indicating cardioprotective cholesterol levels are also decreased. Some studies have shown variable HDL levels in hypothyroidism, with mild reductions in overt hypothyroidism, whereas in subclinical hypothyroidism, these levels are less consistent.[18] It is also possible that in our study, high levels of metabolic risk factors, such as overweight and obesity, contributed to this finding.[19] The findings of the present investigation confirm the strong association between hypothyroidism and an atherogenic lipid profile with high levels of LDL-C and triglycerides and low levels of HDL-C, a lipid triad that greatly increases the risk for atherosclerosis. Of particular interest was the fact that many patients had two or more lipid abnormalities.[20]

The mechanisms behind the occurrence of dyslipidemia in hypothyroidism involve various components. Thyroid hormones control lipid metabolism. Low-density lipoprotein cholesterol (LDL-C) levels are raised due to the reduced density of the LDL receptor on the liver cell membrane. This reduces the clearance of LDL-C from the blood. As a result, total cholesterol levels are also high.[21] Triglycerides stimulate lipoprotein lipase and hepatic lipase. These enzymes

play a crucial role in the clearance of triglyceride-rich lipoproteins from the blood. Reduced levels of these enzymes in hypothyroidism result in high levels of triglycerides. Thyroid hormones control the synthesis of apolipoproteins A-I and A-II. These apolipoproteins control the levels of high-density lipoprotein cholesterol (HDL-C). Reduced levels of apoA-I result in reduced levels of HDL-C.[22]

In addition, the reduced uptake of cholesterol by the liver and reduced synthesis of bile acids, as seen in hypothyroid states, lead to reduced cholesterol catabolism. However, it is interesting to note that the lipid abnormalities seen in hypothyroidism may, in turn, contribute to the cardiovascular risk factors associated with thyroid dysfunction. For example, the elevated LDL and TG may lead to rapid atherosclerosis, endothelial dysfunction, and ischemic heart disease. In addition, the reduced HDL may weaken the body's natural defense mechanism against cholesterol deposition. Thus, the lipid-thyroid interrelationship is two-way, where hypothyroidism leads to abnormal lipid metabolism, and abnormal lipid metabolism may lead to worsening of the hypothyroid state.[23]

Our findings emphasize the need to investigate lipid profiles in patients with newly diagnosed hypothyroidism. Since >85% of the patient population presented with at least one abnormal lipid level, timely interventions can be initiated. Additionally, thyroid hormone replacement with levothyroxine has been demonstrated to significantly alter lipid levels, especially total cholesterol and LDL-C levels. However, there are reports that lipid abnormalities can persist even after the achievement of euthyroid state, especially in the context of obesity or metabolic syndrome, highlighting the need for comprehensive cardiovascular risk management.[24]

However, the study has some limitations. First of all, the study is cross-sectional in design. It only shows association rather than causality. Secondly, the study is conducted in a single center. Thirdly, the sample size is relatively small. Moreover, the study did not include a euthyroid group for comparative purposes. Finally, the study did not follow the patients for a long period to see the changes in the lipid profile of hypothyroid patients following the administration of thyroid hormone replacement therapy. Despite the aforementioned limitations of the study, the study is of significant value as it provides the baseline data of the lipid abnormalities in hypothyroid patients.

CONCLUSION

Newly presenting hypothyroid patients have a high prevalence of dyslipidemia, especially hypertriglyceridemia, low HDL-C, and high LDL-C levels. All these are mechanistically linked to decreased thyroid hormone activity on lipid metabolism and are a major contributor to cardiovascular risk in these patients. Hence, it is of utmost importance to incorporate this into the management of hypothyroidism, in addition to thyroid hormone replacement.

Furthermore, our study also emphasizes the significance of adopting a multidisciplinary approach in managing hypothyroidism, where endocrinology, cardiology, and primary care perspectives are considered in a holistic approach to managing this condition. It is also of great significance to educate patients regarding lifestyle modifications, dietary habits, and risk factors for cardiovascular disease. It is also worth considering overweight and obese patients as a high-risk subgroup, where preventive strategies could be initiated in these patients.

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Authors Contribution:
Muhammad Usman: contributed to study conception, data collection, statistical analysis, and manuscript drafting.
Mohammad Bilal: contributed to data collection, literature review, and manuscript preparation
Dr. Tahir Hussain: contributed to data collection, literature review, and manuscript preparation.
Muhammad Khalid: supervised the study, contributed to study design, interpretation of data, and critical revision of the manuscript.
Kalim Ullah Khan: assisted in data analysis and manuscript editing.
Atif Ullah: contributed to methodological support, physiological interpretation, and final manuscript review.

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