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ORIGINAL ARTICLE

PATTERN OF SERUM LIPID PROFILE IN PATIENTS WITH HYPOTHYROIDISM AT A TERTIARY CARE CENTER OF EASTERN NEPAL

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ABSTRACT

Introduction: *Hypothyroidism is a prevalent endocrine disorder that profoundly disrupts lipid metabolism, thereby increasing cardiovascular risk. Despite a growing burden of thyroid disorders and non-communicable diseases in Nepal, region-specific data characterizing the serum lipid profile of hypothyroid patients from Eastern Nepal remain limited. The aim of the study was to assess the pattern of serum lipid profile and determine the prevalence of dyslipidemia among patients with hypothyroidism attending a tertiary care center in Eastern Nepal, and to evaluate the association between the type and severity of hypothyroidism and lipid abnormalities.*

Materials and Methods: *This hospital-based cross-sectional observational study enrolled 208 adult patients with biochemically confirmed hypothyroidism attending the Medical Outpatient Department of a tertiary care hospital in Eastern Nepal. Sociodemographic and clinical data were collected using a structured questionnaire. Fasting lipid profile parameters were obtained from routine laboratory investigations. Data were analyzed using STATA version 14. Descriptive statistics, independent t-tests, Pearson's correlation, and multivariate logistic regression were used.*

Results: *The mean age of participants was 48.7 ± 13.2 years, with female predominance (65.4%). Overt hypothyroidism was present in 67.8% and subclinical hypothyroidism in 32.2% of participants. The overall prevalence of dyslipidemia was 84.6%. Elevated total cholesterol (TC) was the most common abnormality (71.2%), followed by reduced HDL-C (58.7%), elevated LDL-C (66.8%), and hypertriglyceridemia (51.9%). Mean TC and LDL-C were significantly higher, and mean HDL-C significantly lower, in patients with overt compared to subclinical hypothyroidism (p<0.001 for all). Serum TSH showed a significant positive correlation with TC (r=+0.52), LDL-C (r=+0.49), and TG (r=+0.33), and a significant negative correlation with HDL-C (r=−0.41; all p<0.001). On multivariate logistic regression, independent predictors of dyslipidemia included overt hypothyroidism (adjusted OR 2.41; 95% CI 1.27–4.57; p=0.007), higher TSH levels (adjusted OR 1.47 per 5 mIU/L; 95% CI 1.17–1.85; p=0.001), obesity with BMI ≥25 kg/m² (adjusted OR 1.96; 95% CI 1.12–3.43; p=0.018), and disease duration >5 years (adjusted OR 1.78; 95% CI 1.01–3.15; p=0.048).*

Conclusion: *Dyslipidemia is highly prevalent among patients with hypothyroidism in Eastern Nepal and is significantly more severe in overt hypothyroidism. The strong positive correlation between TSH and atherogenic lipid fractions underscores the importance of routine lipid screening and early treatment optimization in hypothyroid patients to mitigate cardiovascular risk.*

Keywords: *Cardiovascular Risk, Dyslipidemia, Eastern Nepal, Hypothyroidism, Serum Lipid Profile, TSH*

INTRODUCTION

The thyroid hormones are not produced in sufficient amounts in one of the most common endocrine disorders worldwide, known as hypothyroidism, which leads to various metabolic disorders.[1] These hormones regulate lipid homeostasis via modulation of cholesterol biosynthesis, LDL receptor expression and lipoprotein lipase activity in the liver.[2] Hormone deficiency has a negative impact on lipoprotein clearance, leading to accumulation of atherogenic lipoprotein fractions, and an increase in cardiovascular risk.[3,4] Dyslipidemia has been associated with both overt and subclinical hypothyroidism, as characterized by elevated levels of total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C) and triglycerides (TG) and low levels

of high-density lipoprotein cholesterol (HDL-C).[3-5] These derangements result in atherosclerosis and consequent coronary artery disease and/or heart failure.[6,14] This has prompted the general opinion in the international community that screening for lipids is warranted in hypothyroid patients.[5,11] and that lipid abnormalities are to some extent corrected by levothyroxine therapy.[2,3] With the urbanization and lifestyle changes in Nepal, thyroid disorders are becoming a growing public health problem in this country.[7,9] An increase in non-communicable diseases like thyroid dysfunction was also observed in the Nepal STEPS Survey 2019.[6] Dyslipidemia and other cardio metabolic risk factors (CMRFs) have been consistently found to be prevalent in regional studies carried out in hospital settings, where highest prevalence has been observed among the South Asian population.[8,13,15,16] and is exacerbated by obesity in these groups. But, in the eastern part of Nepal, there is limited data about lipid pattern in hypothyroid patient. However, the absence of region-specific evidence is possible due to the high endocrine burden and is geographically dispersed in tertiary care centers, allowing cardiovascular risk stratification to be done effectively.[19-21] Therefore, the present study was planned to assess the lipid profile in serum and to explore the associated factors of dyslipidemia among hypothyroid patient in a tertiary care center of eastern part of Nepal.

MATERIALS AND METHODS

Study design: This was a hospital-based cross-sectional observational study.

Study setting/area: The study was conducted at the Medical Outpatient Department (OPD) of a tertiary care teaching hospital in Eastern Nepal. Data collection was carried out from March 2026 to May 2026.

Study population: The study population comprised adult patients aged ≥18 years with biochemically confirmed hypothyroidism attending the Medical OPD during the data collection period.

- Inclusion Criteria: Biochemically confirmed hypothyroidism (elevated serum TSH with low or normal free T4 per laboratory reference standards), age ≥18 years, and provided written informed consent. Overt hypothyroidism was operationally defined as an elevated serum TSH (>4.0 mIU/L) accompanied by a decreased free T4 (<0.8 ng/dL). Subclinical hypothyroidism was defined as an elevated serum TSH (>4.0 mIU/L) with a free T4 level remaining within the normal reference range (0.8–1.8 ng/dL).
- Exclusion Criteria: Patients currently pregnant or breastfeeding, individuals with severe systemic illness independently affecting lipid metabolism (severe hepatic disease, nephrotic syndrome, end-stage renal disease), patients receiving lipid-lowering therapy (statins or fibrates), or those with incomplete laboratory records.

Sample size

The sample size was calculated using the standard formula for cross-sectional studies described by Lwanga and Lemeshow: $n = (Z^2 \times p \times q) / d^2$. Assuming an expected prevalence (p) of dyslipidemia in hypothyroid patients of 0.60, a 95% confidence level (Z = 1.96), and a 7% margin of error (d = 0.07), the minimum required sample size was 189. After adding a 10% non-response allowance, the final achieved sample size was 208 participants.

Sampling technique

Consecutive sampling was utilized to enroll participants to ensure high recruitment feasibility within the short three-month study duration.

Data collection tools and technique

Data were collected using a structured interviewer-administered questionnaire capturing sociodemographic variables (age, sex, residence, education, occupation) and clinical variables (duration of hypothyroidism, type—overt vs subclinical, comorbidities, current medications including levothyroxine). Body weight was measured using a calibrated digital scale (accurate to 0.1 kg) with participants wearing light clothing without footwear, and height was measured using a portable stadiometer (accurate to 0.1 cm).

Biochemical data, including serum TSH, free T4, and fasting lipid profile parameters (TC, TG, HDL-C, LDL-C), were obtained from routine fasting laboratory investigations advised as part of standard clinical care following a verified minimum 8-hour fast. Fasting lipid parameters were analyzed using enzymatic colorimetric methods on a Beckman Coulter AU480 auto-analyzer (Beckman Coulter Inc., Brea, CA, USA). Serum levels of TSH and free T4 were determined by a chemiluminescence immunoassay (CLIA) method using Mindray CLIA-2000i or Siemens ADVIA Centaur CP immunoassay systems, with proprietary reagent kits.

Variables/Measurements

- Body Mass Index (BMI): Weight (kg)/height (m^2). BMI (kg/m^2) was used as an operational definition of obesity with the help of South Asian specific BMI

reference values.

- Dyslipidemia: Defined according to NCEP ATP III criteria as TC >200 mg/dL, and/or TG >150 mg/dL, and/or LDL-C >130 mg/dL, and/or HDL-C <40 mg/dL for men or <50 mg/dL for women.

Statistical analysis used

The data has been entered into Microsoft Excel 2019 and analyzed using STATA version 14.0. The frequency and percentage were used to present the categorical variables and the normally distributed continuous variables (checked by Shapiro-Wilk test, histogram, and QQ plots) were presented as mean ± standard deviation. Independent t tests were used to compare lipid parameters in the overt and subclinical groups and Pearson's correlation coefficients were used to assess the relationship between TSH and lipids. Independent predictors of dyslipidaemia were determined by multivariate logistic regression, which was adjusted for age, sex, type of hypothyroidism, TSH level, disease duration, BMI and levothyroxine treatment status. Multicollinearity was rejected using Variance Inflation Factors (VIF) and model fit was verified using the Hosmer-Lemeshow test. The two-tailed p value <0.05 was considered statistically significant.

Ethical consideration

The Institutional Review Committee (IRC) of the institution (IRC No: 018-2026) have given ethical clearance. The study was performed in accordance with the Declaration of Helsinki, and informed written consent was obtained from all subjects prior to inclusion in the study.

RESULTS

Sociodemographic and Clinical Characteristics

A total of 208 patients with hypothyroidism were enrolled. The mean age was 48.7 ± 13.2 years. Female patients constituted the majority (65.4%, n=136), consistent with the well-established female preponderance of thyroid disorders. The majority of participants were from urban areas (62.0%) and had at least secondary-level education (68.8%). Overt hypothyroidism was present in 67.8% (n=141) and subclinical hypothyroidism in 32.2% (n=67). Among enrolled patients, 56.7% (n=118) were already on levothyroxine replacement at the time of enrollment, while 43.3% were either newly diagnosed or not yet on treatment. Common comorbidities included hypertension (26.0%) and diabetes mellitus (13.9%). Detailed sociodemographic and clinical characteristics are presented in Table 1.

Table 1: Sociodemographic and clinical characteristics of study participants (N=208)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	18-30	24	11.5
	31-45	56	26.9
	46-60	79	38.0
	>60	49	23.6
Sex	Male	72	34.6
	Female	136	65.4
Residence	Urban	129	62.0
	Rural	79	38.0
	Illiterate	21	10.1
Education	Primary (1-5)	44	21.2
	Secondary (6-10)	78	37.5
	Higher Secondary & above	65	31.3
Duration of Hypothyroidism	<1 year	47	22.6
	1-5 years	96	46.2
	>5 years	65	31.3
Type of Hypothyroidism	Overt	141	67.8
	Subclinical	67	32.2
Levothyroxine Treatment	Yes	118	56.7
	No / Newly Diagnosed	90	43.3
Comorbidities	None	102	49.0
	Hypertension	54	26.0
	Diabetes Mellitus	29	13.9
	Others	23	11.1

Thyroid Function and Anthropometric Parameters

The mean TSH was 12.4 ± 9.8 mIU/L (median 9.7 mIU/L; IQR 5.2–17.6). Mean free T4 was 0.74 ± 0.31 ng/dL, below the lower limit of the reference range (0.8–1.8 ng/dL). The mean BMI of the study population was 26.2 ± 4.7 kg/m², with 52.4% meeting criteria for obesity (BMI ≥25 kg/m²). Table 2 presents thyroid and anthropometric parameters.

Table 2: Thyroid function tests and anthropometric parameters (N=208)

Parameter	Mean ± SD	Median (IQR)	Reference Range
TSH (mIU/L)	12.4 ± 9.8	9.7 (5.2-17.6)	0.4-4.0
Free T4 (ng/dL)	0.74 ± 0.31	0.78 (0.52-0.94)	0.8-1.8
BMI (kg/m²)	26.2 ± 4.7	25.8 (23.1-28.9)	—

Lipid Profile and Prevalence of Dyslipidemia

The overall prevalence of dyslipidemia (any abnormal lipid parameter per NCEP ATP III criteria) was 84.6%

(n=176). Elevated TC (>200 mg/dL) was the most frequent abnormality, affecting 71.2% of participants, followed by elevated LDL-C (66.8%), reduced HDL-C (58.7%), and hypertriglyceridemia (51.9%). Mean serum levels were: TC 224.3 ± 46.7 mg/dL, LDL-C 146.2 ± 41.3 mg/dL, TG 162.4 ± 58.9 mg/dL, and HDL-C 43.6 ± 9.8 mg/dL. Table 3 presents lipid profile parameters and prevalence of individual abnormalities.

Table 3: Lipid profile parameters and prevalence of dyslipidemia (N=208)

Lipid Parameter (Abnormality Threshold)	Mean ± SD	Abnormal (n)	Prevalence (%)
Total Cholesterol (TC) >200 mg/dL	224.3 ± 46.7 mg/dL	148	71.2
LDL-C >130 mg/dL	146.2 ± 41.3 mg/dL	139	66.8
Triglycerides (TG) >150 mg/dL	162.4 ± 58.9 mg/dL	108	51.9
HDL-C <40 mg/dL (M) / <50 mg/dL (F)	43.6 ± 9.8 mg/dL	122	58.7
Dyslipidemia (any parameter abnormal)	—	176	84.6

Abbreviations: TC = Total Cholesterol; TG = Triglycerides; LDL-C = Low-density lipoprotein cholesterol; HDL-C = High-density lipoprotein cholesterol; NCEP ATP III = National Cholesterol Education Program Adult Treatment Panel III

Comparison of Lipid Parameters by Type of Hypothyroidism

Patients with overt hypothyroidism exhibited significantly higher mean TC (231.6 ± 48.2 vs 209.4 ± 41.1 mg/dL; p<0.001), TG (172.8 ± 61.4 vs 143.2 ± 52.7 mg/dL; p=0.001), and LDL-C (154.7 ± 43.8 vs 130.1 ± 36.2 mg/dL; p<0.001), and significantly lower mean HDL-C (41.2 ± 9.4 vs 47.8 ± 9.9 mg/dL; p<0.001) compared to those with subclinical hypothyroidism. The prevalence of dyslipidemia was higher in overt (89.4%) than subclinical hypothyroidism (74.6%; p=0.007). Table 4 summarizes these comparisons.

Table 4: Comparison of lipid profile parameters between overt and subclinical hypothyroidism (N=208)

Lipid Parameter	Overt (n=141)	Subclinical (n=67)	p-value	Reference (NCEP ATP III)
TC (mg/dL)	231.6 ± 48.2	209.4 ± 41.1	<0.001	>200 mg/dL
TG (mg/dL)	172.8 ± 61.4	143.2 ± 52.7	0.001	>150 mg/dL
LDL-C (mg/dL)	154.7 ± 43.8	130.1 ± 36.2	<0.001	>130 mg/dL
HDL-C (mg/dL)	41.2 ± 9.4	47.8 ± 9.9	<0.001	<40/<50 mg/dL
Dyslipidemia (%)	89.4	74.6	0.007	—

p-values derived from independent samples t-test (continuous variables) and chi-square test (dyslipidemia prevalence).

Correlation between TSH and Lipid Parameters

Pearson's correlation analysis demonstrated a significant positive correlation between serum TSH and TC (r=+0.52, p<0.001), LDL-C (r=+0.49, p<0.001), and TG (r=+0.33, p<0.001), and a significant negative correlation between TSH and HDL-C (r=−0.41, p<0.001). These findings indicate that progressive elevation of TSH—reflecting worsening hypothyroidism—is independently associated with a more adverse lipid phenotype. Table 5 presents the correlation coefficients.

Table 5: Pearson's correlation between Serum TSH and lipid parameters (N=208)

Lipid Parameter	Pearson's r (vs TSH)	p-value	Interpretation
Total Cholesterol (TC)	0.52	<0.001	Moderate positive correlation
LDL-C	0.49	<0.001	Moderate positive correlation
Triglycerides (TG)	0.33	<0.001	Weak positive correlation
HDL-C	−0.41	<0.001	Moderate negative correlation

Multivariate Logistic Regression: Predictors of Dyslipidemia

On multivariate logistic regression, adjusting for age, sex, disease duration, BMI, and levothyroxine treatment status, overt hypothyroidism (adjusted OR 2.41; 95% CI 1.27–4.57; p=0.007) and higher TSH levels (adjusted OR 1.47 per 5 mIU/L increment; 95% CI 1.17–1.85; p=0.001) were the strongest independent predictors of dyslipidemia. Longer disease duration >5 years (adjusted OR 1.78; 95% CI 1.01–3.15; p=0.048) and BMI ≥25 kg/m² (adjusted OR 1.96; 95% CI 1.12–3.43; p=0.018) were also independently significant. Even after adjusting for other variables, sex (females) was not a significant independent predictor. However, levothyroxine treatment was associated with lower dyslipidemia risk although this was not statistically significant (adjusted OR 0.63; 95% CI 0.38–1.04; p=0.072). Crude and adjusted ORs are shown in Table 6.

Table 6: Multivariate logistic regression — predictors of dyslipidemia (N=208)

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Overt Vs Subclinical Hypothyroidism	2.84 (1.54-5.23)	0.001	2.41 (1.27-4.57)	0.007
TSH (per 5 mIU/L increment)	1.62 (1.31-2.01)	<0.001	1.47 (1.17-1.85)	0.001
Duration >5 years	2.07 (1.18-3.62)	0.011	1.78 (1.01-3.15)	0.048
BMI ≥25 kg/m² (Obese)	2.23 (1.31-3.80)	0.003	1.96 (1.12-3.43)	0.018
Age (per 10-year increment)	1.31 (1.02-1.68)	0.035	1.24 (0.96-1.60)	0.098
Female Sex	1.18 (0.72-1.93)	0.511	1.09 (0.65-1.84)	0.742
Levothyroxine treatment	0.58 (0.36-0.94)	0.027	0.63 (0.38-1.04)	0.072

Adjusted for: age, sex, type of hypothyroidism, TSH level, disease duration, BMI, levothyroxine treatment status. CI = Confidence Interval; OR = Odds Ratio.

DISCUSSION

In the present cross sectional study of 208 hypothyroid patients at a tertiary hospital in eastern part of Nepal, overall prevalence of dyslipidemia was found high (84.6%) with most common abnormality being high TC (71.2%). Overt hypothyroidism, elevated TSH, longer disease duration and concurrent obesity were found to be independent predictors of dyslipidemia. The results of this study confirm the known pathophysiological involvement of thyroid hormone in lipid metabolism, and have clinical implications for managing cardiovascular risk in this group of patients.

The prevalence of dyslipidemia in our cohort (84.6%) is consistent with, and at the upper end of, figures reported in comparable hospital-based studies from South Asia [10]. Prior clinical series have documented dyslipidemia in 60–85% of overt hypothyroid patients.[3,4] The high prevalence in our study may be attributable to the predominance of overt hypothyroidism (67.8%), higher mean TSH values, and the substantial proportion of untreated or newly diagnosed patients (43.3%), all of which are expected to amplify lipid abnormalities.

The predominance of elevated TC and LDL-C in our cohort mirrors the characteristic lipid phenotype of hypothyroidism driven primarily by reduced hepatic LDL receptor expression and impaired lipoprotein lipase activity secondary to thyroid hormone deficiency.[2,5] The consequent reduction in LDL receptor-mediated clearance of circulating LDL particles is linked to a disproportionately atherogenic hypercholesterolemia. The finding that more than half of patients had reduced HDL-C (58.7%) is clinically significant, as low HDL-C is an independent cardiovascular risk factor not typically corrected by lipid-lowering therapy alone, and requires lifestyle modification alongside thyroid hormone replacement.[11,18]

The significantly worse lipid profile in overt versus subclinical hypothyroidism—with markedly higher TC, LDL-C, and TG, and lower HDL-C in overt disease—is consistent with the dose-response relationship between the degree of thyroid hormone deficiency and the severity of lipid derangement [3,14]. This difference was also shown on the basis of the significant positive correlation between serum TSH and aTHL (TC: r=+0.52; LDL-C: r=+0.49) and the negative correlation with HDL-C (r=−0.41). These correlations are similar to those found in similar regions, which show the cardiovascular importance of thyroid dysfunction in Nepalese populations. Thyroid dysfunction has also been found in a high proportion of patients with acute coronary syndrome[19] and, therefore, there is a cardiovascular dimension to thyroid dysfunction as well. This independent association between overt hypothyroidism and dyslipidemia (adjusted OR 2.41) and between TSH elevation and dyslipidemia (adjusted OR 1.47 per 5 mIU/L increment) after multivariate adjustment underscores thyroid disease severity as a primary factor that is associated with lipid abnormalities in this population. There is a strong correlation between TSH and a more and more deleterious lipid profile. Interestingly, obesity (BMI≥25 kg/m2; adjusted OR 1.96) was an independent risk factor for dyslipidemia in our hypothyroid population, highlighting the combination of adiposity with cardio metabolic risk. Cardio metabolic risk is known to begin at lower BMI level among South Asian populations and there is well-documented relationship between hypothyroidism and visceral adiposity in the context of dyslipidemia.[15,16,17] Although the trend was toward lower dyslipidemia risk with levothyroxine treatment (adjusted OR 0.63; P=0.072), this was unconvincing with the current data, in part because of the small size of the study and the variability in treatment duration and effectiveness among those treated with levothyroxine. Studies of larger populations have consistently demonstrated that with proper levothyroxine replacement, there is a decrease in both TC and LDL-C; however, there are more variable results with TG and HDL-C.[3,5,11] These results illustrate the need not only to start levothyroxine treatment, but to attain biochemical euthyroidism and keep it up to achieve an optimized lipid profile. Findings

of the high overall rate of dyslipidaemia (84.6%) along with the lipid abnormalities that were atherogenic in most of our patients highlight the importance of routine lipids screening in all hypothyroid patients irrespective of whether they have overt or subclinical hypothyroidism. It's in line with ATA and ETA guideline recommendations.[5,11] and is especially important in the region of Eastern Nepal where cardiovascular risk factors are rising, and where specialist access and follow-up is limited. Other recent studies in Nepal also confirm the extent of lipid abnormality among hypothyroid patients in this area.[19,20,21]

CONCLUSION

The study shows that Dyslipidaemia is very common (84.6%) among a group of patients with hypothyroidism at tertiary care centre in eastern Nepal. The major lipid abnormality is an elevated TC and LDL-C, and appears to be much more pronounced in overt hypothyroidism than in subclinical hypothyroidism. Serum TSH is significantly and positively correlated with atherogenic lipid fractions, thus establishing the dose dependent association between the deficit of thyroid hormone and lipid derangement. The factors associated with an independent prediction of dyslipidemia include overt hypothyroidism, longer duration of hypothyroidism, and concurrent obesity.

The results of this study highlight the need to maintain regular monitoring of lipid profile in hypothyroidism patients since they are at risk for cardiovascular disease due to the presence of lipid abnormalities. Biochemical euthyroidism may be achieved and maintained with the use of an appropriate levothyroxine therapy, which could lead to an improvement of lipid parameters and cardiovascular risk reduction. A holistic approach to patients with hypothyroidism, which involves thyroid hormone replacement, periodic monitoring of lipids, and lifestyle changes like regular exercise and a nutritious diet, could help improve long-term prognosis in Eastern Nepal.

CONFLICT OF INTEREST: None

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