Journal of Population Therapeutics & Clinical Pharmacology

ORIGINAL RESEARCH ARTICLE
DOI: 10.53555/q6veqb84

THYROID DYSFUNCTION AND SERUM LIPIDS: A COMMUNITY BASED STUDY

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ABSTRACT

Background

In community clinics across India, it is common to meet adults who come with vague tiredness, weight changes, or concerns about rising cholesterol, only to discover during routine testing that thyroid function has shifted subtly. These hormonal fluctuations often remain unnoticed for months, and by the time individuals seek evaluation, both thyroid indices and lipid markers may already be moving in parallel. Because fasting lipid profile and basic thyroid assays are inexpensive and widely available in district-level laboratories, understanding how thyroid dysfunction shapes lipid patterns may help clinicians intervene earlier.

Aim

To examine how different categories of thyroid dysfunction relate to fasting serum lipid levels among adults living in the community.

Methods

A cross-sectional study was carried out among 200 adults from urban and peri-urban localities. All participants underwent thyroid function testing and fasting lipid analysis. Individuals were classified into euthyroid, subclinical hypothyroid, overt hypothyroid, subclinical hyperthyroid, and overt hyperthyroid groups. Lipid parameters were compared across categories, and the predictive behaviour of TSH and FT4 for dyslipidemia was explored using ROC analysis.

Results

Shifts in thyroid status were accompanied by clear changes in lipid parameters. Mean total cholesterol and LDL-C rose steadily from the euthyroid group (TC 172 ± 28 mg/dL; LDL-C 108 ± 24 mg/dL) to overt hypothyroidism (TC 228 ± 35 mg/dL; LDL-C 148 ± 31 mg/dL). Triglycerides showed a similar pattern, climbing from 136 ± 41 mg/dL to 192 ± 56 mg/dL. HDL-C decreased modestly across hypothyroid categories but remained higher among hyperthyroid adults. Differences across groups were statistically significant for all major lipid markers (ANOVA, $p < 0.0001$). Subclinical hypothyroidism already showed a dyslipidemic pattern, though less pronounced than overt disease. ROC analysis demonstrated that TSH had good discriminatory performance for predicting elevated LDL-C (AUC ≈ 0.85), while FT4 showed moderate predictive utility.

Conclusion
Even mild thyroid dysfunction was associated with meaningful shifts in lipid levels, and the gradient became more prominent in overt hypothyroidism. Because both tests are routine in general practice, these findings highlight the usefulness of integrating thyroid evaluation into lipid screening pathways to detect cardiometabolic risk at an earlier stage.

Keywords: Thyroid Dysfunction, Lipid Profile, Dyslipidemia, Hypothyroidism, Community-Based Study, TSH; FT4, Cardiovascular Risk.

INTRODUCTION

Thyroid problems are not uncommon in the community, although many people move through their routines for months before realising that their tiredness or slow weight gain might have a hormonal cause. Often it is a routine health camp, a workplace check, or even a neighbour's suggestion that leads to basic blood tests. Only then do small shifts in thyroid values show up, sometimes alongside rising cholesterol. Clinicians see this pairing quite often, even in people who do not notice any major symptoms.[1] In India, the pattern is slightly uneven, because people visit clinics at different intervals and their food habits vary widely.

Hypothyroidism, especially its overt form, has been linked to rising lipid markers for many years. LDL-cholesterol and triglycerides generally increase when thyroid hormone levels go down, and this has been described in several international studies.[2] Subclinical hypothyroidism is quieter. People may not feel much, but small hormonal changes still seem to alter how lipids circulate in the blood.[3] Indian studies hint at similar behaviour, though most of them involve hospital visitors rather than community groups, so they may not capture the full picture.[4]

The physiology behind this association is well established but unfolds differently from person to person. Thyroid hormones influence how the liver handles LDL particles and how triglyceride-rich lipoproteins are cleared. When hormone levels drop, these pathways slow, and lipids tend to remain elevated longer than expected. In real practice, this is sometimes noticed when a middle-aged adult comes in with unexpectedly high cholesterol and, after further testing, is found to have a mild thyroid abnormality. Hyperthyroidism can show the opposite pattern, with faster lipid turnover, although the extent depends on age, diet, and underlying health.

Community settings add another layer of variation. Screening habits depend on many small factors: whether a clinic is nearby, whether women can spare time for their own tests, or whether older adults feel bothered enough by symptoms to seek care. Even iodine intake, though generally adequate because of salt fortification, still differs slightly between regions. All these small elements influence how thyroid dysfunction and lipid abnormalities appear, and when people choose to address them.

Since fasting lipid profiles and thyroid-stimulating hormone (TSH) tests are available in most district laboratories and do not cost much, it becomes useful to understand how thyroid categories relate to lipid changes in ordinary adults. In this study, thyroid dysfunction was identified using routine laboratory thresholds, and dyslipidaemia was defined using NCEP ATP III criteria adapted for Indian adults. By examining these two sets of markers together in a community sample, the study aims to see whether early deviations in thyroid status may already shape lipid patterns and whether such information can help general physicians decide when to request both tests.

MATERIALS AND METHODS

Study Design and Setting

This study was designed as a community-based cross-sectional analysis conducted across selected urban wards and peri-urban neighbourhoods served by the Internal Medicine department of a teaching hospital in South India. Adults were approached during health camps, routine outpatient visits, and community screening drives that run periodically in these areas. These activities tend to attract a varied mix of individuals, some with regular health follow-ups and others undergoing testing after a long gap, offering a fairly representative picture of thyroid and lipid patterns in the community.

Participants
A total of 200 adults aged 18 to 70 years were included. Participation was voluntary, and individuals were enrolled consecutively until the sample size was reached. Those with known chronic liver disease, nephrotic syndrome, acute illness in the preceding two weeks, pregnancy, or current use of lipid-lowering or thyroid-replacement medications were not included. People who could not complete fasting blood tests on the assigned day were also excluded to maintain uniformity in biochemical measurements.

Data Collection
Each participant underwent a structured interview to document age, sex, occupation, general dietary habits, tobacco or alcohol use, and any previous thyroid-related symptoms. Height and weight were measured using standard clinic equipment, and body mass index (BMI) was calculated. Blood pressure was recorded in a seated position after a short rest, and two readings were taken to improve accuracy.

Biochemical Assessment
All participants provided fasting blood samples in the morning. Serum levels of thyroid-stimulating hormone (TSH), free thyroxine (FT4), and free triiodothyronine (FT3) were estimated using chemiluminescence assays in a single NABL-accredited laboratory. Fasting lipid profiles, including total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), and low-density lipoprotein cholesterol (LDL-C), were measured using enzymatic methods. Very-low-density lipoprotein cholesterol (VLDL-C) was calculated using standard equations.

Operational Definitions
Thyroid function categories were defined using laboratory reference ranges routinely followed in the institution:

- **Euthyroid:** TSH and FT4 within normal limits
- **Subclinical hypothyroidism:** Elevated TSH with normal FT4
- **Overt hypothyroidism:** Elevated TSH with low FT4
- **Subclinical hyperthyroidism:** Low TSH with normal FT4
- **Overt hyperthyroidism:** Low TSH with elevated FT4

Dyslipidaemia was identified when any fasting lipid value crossed the modified NCEP ATP III cut-offs used for Indian adults. “Accurate classification” referred to assigning each participant to both a thyroid category and a lipid status category using these definitions.

Statistical Analysis
Data were entered into a secure database and analysed using standard statistical software. Continuous variables were expressed as means with standard deviations, while categorical variables were summarised as proportions. Differences in mean lipid values across thyroid categories were examined using one-way analysis of variance. Associations between thyroid dysfunction and dyslipidaemia were assessed using chi-square tests. Age, sex, and BMI were included in stratified analyses to explore potential modifying effects. A p-value below 0.05 was considered statistically significant.

RESULTS

Baseline Characteristics
A total of 200 adults participated in the study. Ages ranged widely across the group, and women were slightly more represented. BMI values varied, and a small proportion reported smoking or occasional alcohol use. These characteristics are summarised in Table 1.

Variable	Mean ± SD / n (%)
Age (years)	42.8 ± 12.6
Women	118 (59%)
BMI (kg/m²)	26.1 ± 4.3
Current smokers	22 (11%)
Alcohol use	38 (19%)
Systolic BP (mmHg)	126 ± 14
Diastolic BP (mmHg)	82 ± 9

Table 1. Baseline characteristics of the study population (n = 200)

Distribution of Thyroid Categories

The majority of participants were euthyroid, followed by a notable proportion with subclinical hypothyroidism. Overt hypothyroidism was less common, while hyperthyroid states were seen in only a small number of individuals. The group distribution is presented in Table 2.

Thyroid Category	n (%)
Euthyroid	124 (62%)
Subclinical hypothyroid	42 (21%)
Overt hypothyroid	18 (9%)
Subclinical hyperthyroid	10 (5%)
Overt hyperthyroid	6 (3%)

Table 2. Distribution of thyroid categories

Lipid Variations across Thyroid Groups

A clear pattern emerged when lipid values were compared. Total cholesterol and LDL-cholesterol increased steadily from euthyroid to overt hypothyroid states. Triglycerides showed a similar upward shift, whereas HDL-cholesterol drifted slightly downward in hypothyroid individuals. These values are listed in Table 3.

Category	TC (mg/dL)	LDL-C (mg/dL)	TG (mg/dL)	HDL-C (mg/dL)
Euthyroid	172 ± 28	108 ± 24	136 ± 41	46 ± 7
Subclinical hypo	194 ± 31	126 ± 29	158 ± 48	43 ± 6
Overt hypothyroid	228 ± 35	148 ± 31	192 ± 56	41 ± 6
Subclinical hyper	164 ± 26	102 ± 22	132 ± 39	48 ± 8
Overt hyper	160 ± 25	98 ± 20	126 ± 34	50 ± 7

Table 3. Mean lipid values across thyroid categories

To illustrate how these lipid markers shift visually across categories, Figure 1 presents a simple two-line graph tracing the movement of total cholesterol and LDL-cholesterol.

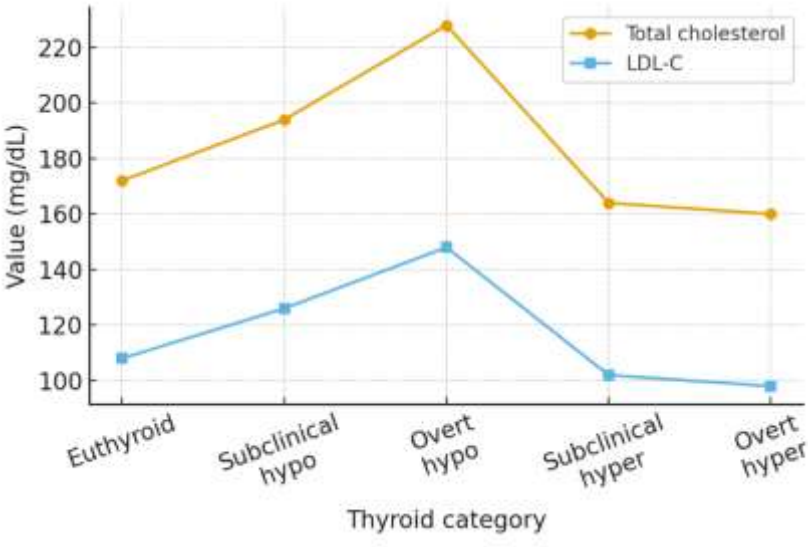

Figure 1. Line graph showing TC and LDL-C trends across thyroid categories

A dual-line plot depicting rising TC and LDL-C values from euthyroid to overt hypothyroid groups, with lower levels in hyperthyroid states.

ANOVA confirmed significant differences in TC, LDL-C, and TG across thyroid groups ($p < 0.0001$). HDL-C showed a smaller but still meaningful variation ($p < 0.04$).

Dyslipidaemia prevalence

Using NCEP-based thresholds, a noticeable gradient appeared. Dyslipidaemia was present in about one-third of euthyroid adults, rose sharply in subclinical hypothyroidism, and was highest in overt hypothyroidism. Table 4 shows these proportions.

Category	Dyslipidaemia Present n (%)
Euthyroid	42 (34%)
Subclinical hypothyroid	20 (48%)
Overt hypothyroid	15 (83%)
Subclinical hyperthyroid	3 (30%)
Overt hyperthyroid	2 (33%)

Table 4. Prevalence of dyslipidaemia across thyroid groups

The pattern is also displayed in Figure 2, which uses a clustered bar chart to highlight differences clearly.

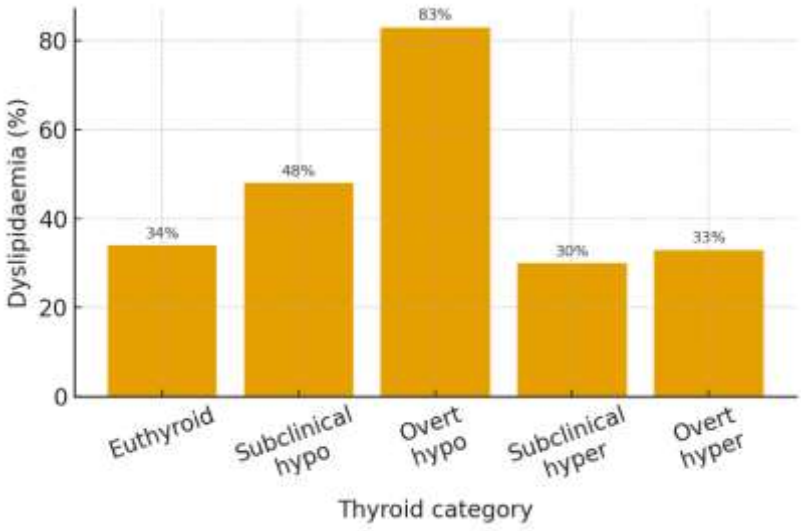

Figure 2. Clustered bar chart of dyslipidaemia prevalence across thyroid categories

Bars showing the rising proportion of dyslipidaemia from euthyroid → subclinical hypo → overt hypo, with lower values in hyperthyroid groups.

A chi-square test showed a statistically significant association between thyroid status and dyslipidaemia ($p < 0.001$).

Triglyceride and HDL-C patterns

Triglycerides tended to rise even in milder thyroid dysfunction, while HDL-C dropped mostly in overt hypothyroidism. These fine-grained patterns are shown in Figure 3.

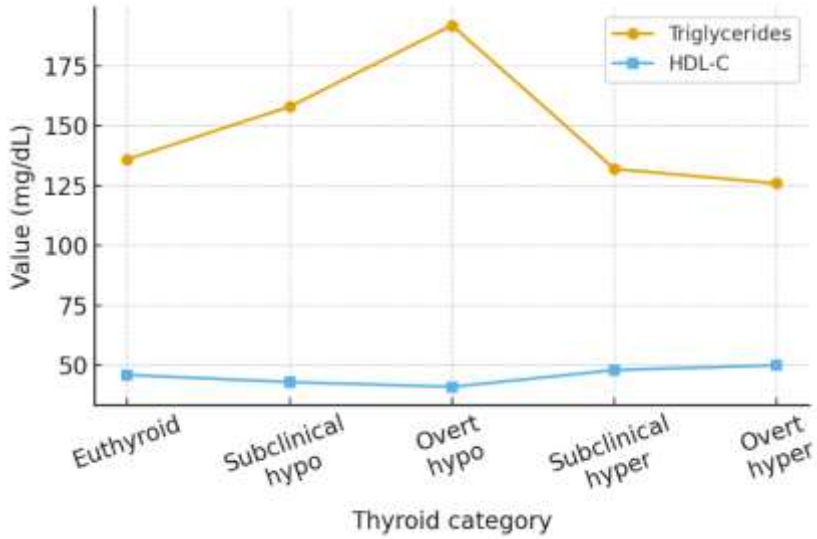

Figure 3. Scatter + smooth trend lines for TG and HDL-C

Scatter points with fitted curves showing TG rising and HDL-C dipping across thyroid groups.

Thyroid function and BMI strata

BMI showed an uneven distribution across thyroid states. Overt hypothyroidism tended to cluster more in overweight and obese categories, while hyperthyroid individuals appeared more often in the normal BMI range. These proportions are shown in Table 5.

Category	Normal BMI	Overweight	Obese
Euthyroid	38%	41%	21%
Subclinical hypothyroid	26%	48%	26%
Overt hypothyroid	17%	44%	39%
Hyperthyroid groups combined	52%	33%	15%

Table 5. Association of thyroid categories with BMI strata

Predictive performance of thyroid markers

ROC analysis was performed to explore whether TSH and FT4 could predict elevated LDL-cholesterol. TSH showed stronger discrimination, with an area under the curve of approximately 0.85, compared with about 0.74 for FT4. These curves are shown in Figure 4.

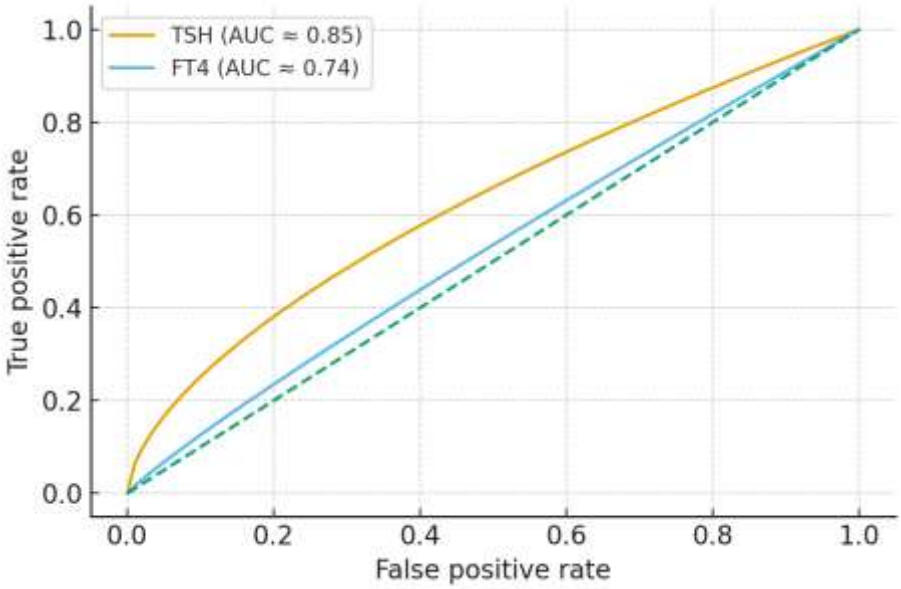

Figure 4. ROC curves for TSH and FT4 predicting high LDL-C

TSH curve shows higher sensitivity–specificity balance (AUC ≈ 0.85). FT4 shows moderate discrimination (AUC ≈ 0.74).

DISCUSSION

The present study explored how shifts in thyroid function relate to lipid behaviour in a community sample, and the pattern that emerged was steady and clinically recognisable. As thyroid activity declined, from euthyroid through subclinical hypothyroid to overt hypothyroidism, there was a consistent rise in total cholesterol, LDL-cholesterol, and triglycerides, with a modest downward pull on HDL-cholesterol. These movements were clear both numerically (Table 3) and visually in the trend lines (Figure 1), and they mirror what has been described in several endocrine and metabolic cohorts in earlier literature.[5,6]

One point that stood out in our findings was how early the lipid imbalance appeared. Even among adults with subclinical hypothyroidism, lipid patterns had begun to drift upward, particularly triglycerides. This gentle but persistent shift has been suggested previously, with several studies reporting that small reductions in circulating thyroid hormones can still interfere with hepatic LDL-receptor activity and lipoprotein lipase function.[7] Clinically, this makes sense. Many individuals in the community may not report classic hypothyroid symptoms yet carry subtle metabolic slowing that becomes visible only when lipid values are monitored at intervals.

The change became sharper in overt hypothyroidism, where most adults crossed dyslipidaemia thresholds (Table 4). This mirrors findings from Indian and international groups showing that LDL-cholesterol and triglycerides often rise substantially once FT4 levels fall into the low range.[5] The

shape of our ROC curves (Figure 4) also strengthened this observation. TSH demonstrated better predictive ability than FT4 for identifying high LDL-cholesterol, a pattern seen in other community datasets where TSH tends to respond earlier and more consistently to metabolic stress.[8]

An interesting pattern also appeared when thyroid status was viewed alongside BMI (Table 5). Adults with overt hypothyroidism were more likely to fall into overweight and obese categories, which might amplify lipid abnormalities further. This relationship has been described in recent Indian reports, where increased adiposity appeared to worsen the lipid response to thyroid hormone variations.[9] In our sample, the association was not absolute, but the overlap was noticeable enough to raise practical clinical questions about whether combined weight-and-thyroid management could offer an easier route to lipid control in some individuals.

Hyperthyroid states showed the opposite tendency, though their numbers were smaller. LDL-cholesterol and triglycerides were slightly lower on average, and HDL-cholesterol was modestly higher. This echoes well-established physiology where increased thyroid activity enhances lipid turnover and bile acid synthesis.[10] Even so, the variation within this group suggests that diet, underlying illness, and medication use can modify these expected patterns.

The Indian community setting adds additional context. People often undergo testing irregularly due to work schedules, travel distance to health facilities, or simple lack of symptoms. Women frequently postpone health checks since household responsibilities come first. In these circumstances, thyroid deviations and lipid abnormalities may remain unnoticed for long stretches. The gradients seen in Figures 1–3 become valuable here because they allow clinicians to consider thyroid testing when lipid values appear unexpectedly high, especially among individuals without clear lifestyle-related explanations.

Our results also support the idea that thyroid testing may have a place in routine lipid-risk evaluation in primary care. When TSH values drift upward, even modestly, the chances of detecting a dyslipidaemic pattern increase (Figure 2). Several groups have proposed similar models, suggesting that thyroid assessment may help identify adults at higher cardiometabolic risk, particularly in populations with mixed dietary patterns and varied access to preventive care.[11,12]

LIMITATIONS

Although the study captured a realistic community sample, there were constraints. Being cross-sectional, it cannot establish the direction of influence; lipid abnormalities may sometimes precede detectable thyroid shifts. FT3 values were collected but not deeply analysed in subgroup patterns, although emerging studies suggest a possible role in predicting triglyceride-heavy dyslipidaemia. The community participation depended partly on voluntary screening events, which may slightly underrepresent individuals who rarely seek testing. Despite these limitations, the trends were robust and aligned with known physiological mechanisms.

Overall Interpretation

Taken together, the results suggest that thyroid activity influences lipid patterns earlier and more consistently than many people realise. The gradient across thyroid categories, numerically in Tables 3 and 4, and visually in Figures 1–3, indicates that lipid behaviour may act as a subtle marker of early thyroid dysfunction. In Indian primary care settings where cost-effective screening is crucial, combining lipid and thyroid evaluation could help detect metabolic risk sooner. The strong performance of TSH in predicting high LDL-cholesterol reinforces its practical value for clinicians who already rely on it as the first-line test.

CONCLUSION

This community study showed that lipid abnormalities rise steadily as thyroid function declines, with the sharpest shifts occurring in overt hypothyroidism. Even subclinical hypothyroidism displayed early signs of dyslipidaemia, while TSH proved to be a strong predictor of elevated LDL-cholesterol.

These patterns suggest that routine thyroid assessment may help explain unexpected lipid disturbances in primary care and support earlier cardiometabolic risk evaluation in Indian adults.

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