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Pattern of Thyroid Dysfunction and Its Association with Metabolic Parameters among Adults Attending a General Medicine Clinic: A Cross-Sectional Observational Study.

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Abstract

Background:
Thyroid dysfunction is frequent in adult outpatient practice and may coexist with major metabolic abnormalities.

Objective:
To assess the pattern of thyroid dysfunction and its association with metabolic parameters among adults attending a General Medicine clinic.

Methods:
This cross-sectional observational study included 100 adults attending the General Medicine clinic at Government Medical College, Nizamabad, Telangana, India, from January to December 2025. Demographic details, anthropometry, thyroid profile, fasting plasma glucose, HbA1c, and lipid profile were recorded. Participants were classified as euthyroid or having thyroid dysfunction. Metabolic parameters were compared using the independent t-test and chi-square test.

Results:
The mean age was 43.8 ± 12.6 years, and 58.0% were females. Thyroid dysfunction was observed in 38.0%; subclinical hypothyroidism was most common (20.0%), followed by overt hypothyroidism (10.0%), subclinical hyperthyroidism (5.0%), and overt hyperthyroidism (3.0%). Thyroid dysfunction was more frequent among females than males (46.6% vs. 26.2%; χ^2=4.28, p=0.039). Compared with euthyroid adults, those with thyroid dysfunction had higher BMI (28.1 ± 4.5 vs. 25.3 ± 3.8 kg/m², p=0.002), waist circumference (94.2 ± 11.1 vs. 86.8 ± 9.6 cm, p=0.001), HbA1c (6.5 ± 1.1% vs. 5.9 ± 0.8%, p=0.006), total cholesterol (207.8 ± 42.5 vs. 178.4 ± 34.6 mg/dL, p<0.001), triglycerides (181.9 ± 61.8 vs. 142.6 ± 52.4 mg/dL, p=0.001), and LDL cholesterol (130.6 ± 35.4 vs. 104.8 ± 28.7 mg/dL, p<0.001). Metabolic syndrome was more frequent with thyroid dysfunction (60.5% vs. 24.2%; χ^2=13.20, p<0.001).

Conclusion:
Thyroid dysfunction, mainly subclinical hypothyroidism, was common and significantly associated with adverse metabolic parameters.

Recommendations:
Thyroid screening should be considered in adults with obesity, dysglycemia, dyslipidemia, or metabolic syndrome.

Keywords: *Thyroid dysfunction; Subclinical hypothyroidism; Metabolic syndrome; Dyslipidemia; Thyroid-stimulating hormone.*
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Introduction

Thyroid hormones are central regulators of basal metabolic rate, thermogenesis, lipid turnover, carbohydrate metabolism, and cardiovascular function. Even small disturbances in thyroid hormone availability can alter energy expenditure, adiposity, serum lipoproteins, vascular tone, and insulin sensitivity [1-2]. Thyroid dysfunction, particularly hypothyroidism and subclinical hypothyroidism, is therefore clinically relevant beyond the classic symptoms of fatigue, weight gain, cold intolerance, and menstrual irregularity. In outpatient medicine, many adults present with nonspecific complaints or metabolic comorbidities, and biochemical thyroid testing often reveals previously unrecognized abnormalities [3-4].

The epidemiology of thyroid dysfunction varies by iodine status, age, sex, population selection, and diagnostic thresholds. Indian epidemiological data indicate a substantial burden of hypothyroidism in adults, with higher prevalence among women and older individuals [2]. International population studies such as NHANES III and the Colorado Thyroid Disease Prevalence Study have also demonstrated that abnormal thyroid function is common, frequently undetected, and associated with measurable changes in lipid variables and cardiovascular risk profiles [3,4]. Subclinical thyroid dysfunction is particularly important because patients often lack overt clinical signs while still showing biochemical and cardiometabolic changes [5,6].

The metabolic consequences of thyroid dysfunction are biologically plausible and clinically important. Hypothyroidism reduces hepatic LDL receptor activity, impairs cholesterol clearance, and contributes to elevated total cholesterol and LDL cholesterol. Thyroid hormones also influence lipoprotein lipase activity, triglyceride metabolism, bile acid synthesis, and hepatic lipid processing [7-9]. Several community-based and interventional studies have reported positive associations between TSH levels and total cholesterol or LDL cholesterol, although the magnitude of association is variable in subclinical disease [9-11]. These effects are relevant in general medicine settings where dyslipidemia, obesity, diabetes mellitus, and hypertension commonly coexist.

Thyroid dysfunction and metabolic syndrome share overlapping clinical features, including abdominal obesity, dysglycemia, hypertension, hypertriglyceridemia, and reduced HDL cholesterol. Standardized metabolic syndrome criteria emphasize the clustering of these abnormalities because of their combined effect on cardiovascular and diabetes risk [12]. Studies among patients with metabolic syndrome and among Indian adults with type 2 diabetes or hypertension have reported a higher frequency of hypothyroid patterns, supporting the need for integrated endocrine and metabolic evaluation in routine clinical care [13,14]. However, local hospital-based data remain useful because disease patterns differ across regions and patient profiles.

The present study was conducted with the objective of assessing the pattern of thyroid dysfunction among adults attending the General Medicine clinic at Government Medical College, Nizamabad, Telangana, India. The study also aimed to evaluate the association between thyroid dysfunction and metabolic parameters, including body mass index, waist circumference, fasting plasma glucose, HbA1c, lipid profile, and metabolic syndrome.

Methodology

Study design and setting

This hospital-based cross-sectional observational study was conducted in the General Medicine outpatient clinic of Government Medical College, Nizamabad, Telangana, India, from January 2025 to December 2025. Government Medical College, Nizamabad, is a government tertiary care teaching institution that provides outpatient, inpatient, emergency, laboratory, and referral services to adults from Nizamabad and adjoining districts. The institution offers broad specialty and diagnostic services, including General Medicine, General Surgery, Obstetrics and Gynaecology, Paediatrics, Orthopaedics, ENT, Ophthalmology, Dermatology, Psychiatry, Anaesthesiology, Radiology, Pathology, Microbiology, Biochemistry, and allied supportive services. The General Medicine clinic routinely manages noncommunicable and endocrine-metabolic conditions such as diabetes mellitus, hypertension, dyslipidemia, obesity, and thyroid disorders. The design was selected to estimate the clinic-based pattern of thyroid dysfunction and examine its association with metabolic parameters at a single point of clinical evaluation.

Study population

A total of 100 consecutive adults aged 18 years and above who attended the General Medicine clinic during the study period and fulfilled the eligibility criteria were included. Adults who provided written informed consent and underwent thyroid function testing together with metabolic assessment were enrolled. Patients with pregnancy, severe acute illness, chronic liver disease, chronic kidney disease, malignancy, current use of thyroid medication, amiodarone, lithium, systemic corticosteroids, or incomplete

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biochemical data were excluded to reduce measurement bias and confounding.

Study size

The required study size was estimated for a cross-sectional descriptive study using the formula $n = Z^2p(1-p)/d^2$. As local clinic-based prevalence data were limited, p was taken as 50% to obtain the maximum sample size, Z was 1.96 for a 95% confidence level, and absolute precision (d) was fixed at 10%. The calculated sample size was 96.04, which was rounded to 100 adults to compensate for possible non-response or incomplete records and to provide a feasible outpatient-based sample within the study period.

Data collection

Demographic details, including age and sex, were recorded using a structured case-record form. Clinical history was obtained for hypertension, type 2 diabetes mellitus, dyslipidemia, and relevant medication exposure. Anthropometric measurements included body mass index and waist circumference. Body mass index was calculated using measured weight and height and categorized as normal, overweight, or obese according to standard adult clinical categories. Blood pressure status and comorbidities were recorded from clinical assessment and available medical records.

Bias control

Consecutive sampling was used to reduce selection bias. A structured data collection form was applied uniformly to all participants. Standard clinical procedures were used for anthropometric measurements, and laboratory investigations were performed through the institutional laboratory. Patients receiving thyroid medication or drugs known to interfere with thyroid function were excluded. Participants with incomplete biochemical data were not included in the final analysis.

Laboratory assessment and operational definitions

Venous blood samples were collected after overnight fasting, wherever applicable. Thyroid function assessment included serum thyroid-stimulating hormone and thyroid hormone levels interpreted according to institutional laboratory reference intervals. Participants were classified as euthyroid, subclinical hypothyroid, overt hypothyroid, subclinical hyperthyroid, or overt hyperthyroid using accepted biochemical principles [5,6]. Fasting plasma glucose, HbA1c, total cholesterol, triglycerides, LDL cholesterol, and HDL cholesterol were recorded. Metabolic syndrome was assessed using harmonized criteria based on the clustering of abdominal obesity, raised triglycerides, reduced HDL cholesterol, elevated blood pressure, and raised fasting glucose [12].

Statistical analysis

Data were summarized as frequencies and percentages for categorical variables and mean ± standard deviation for continuous variables. Euthyroid participants were compared with participants having thyroid dysfunction. The Pearson chi-square test was used for categorical associations, including sex versus thyroid dysfunction and thyroid dysfunction versus metabolic syndrome. The independent sample t-test was used for comparison of continuous metabolic variables between the two thyroid-status groups. Correlation between TSH and metabolic parameters was assessed using Pearson correlation coefficients. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee, Government Medical College, Nizamabad, Telangana, India, before initiation of the study. The study was conducted in accordance with ethical principles for human research. Written informed consent was obtained from all participants before enrollment. Confidentiality of participant data was maintained by anonymizing records during analysis and reporting.

Results

Participant flow: A total of 100 consecutive adult attendees who satisfied the preliminary clinical screening criteria were identified during the study period. All 100 were examined for eligibility and confirmed to meet the inclusion and exclusion criteria. All eligible participants provided written informed consent and completed thyroid and metabolic investigations. Therefore, 100 participants were included and analyzed. No confirmed eligible participant declined participation, withdrew, or was excluded due to incomplete key data (Figure 1).

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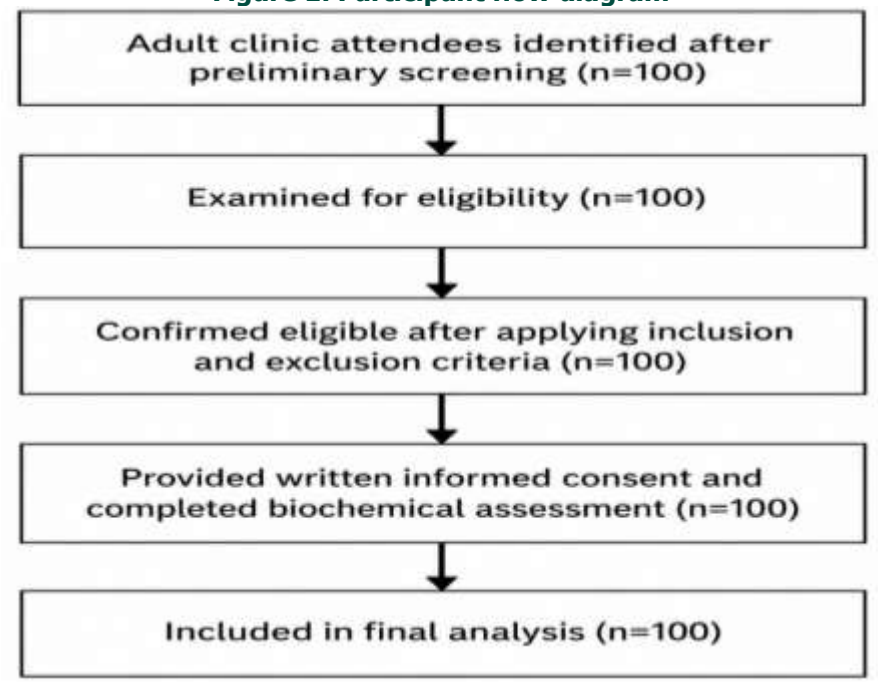
Figure 1. Participant flow diagram



The mean age of the study participants was 43.8 ± 12.6 years. Most participants were aged between 31 and 60 years. Females constituted 58.0% of the study population. The mean BMI was 26.4 ± 4.3 kg/m². Overweight and obesity were observed in 46.0% and 23.0% of participants, respectively. Hypertension, type 2 diabetes mellitus, and dyslipidemia were present in 34.0%, 28.0%, and 46.0% of participants, respectively (Table 1).

Table 1. Baseline demographic and clinical characteristics of the study population (n=100)

Characteristic	n (%) or mean ± SD
Total sample size	100 (100.0)
Age, years	43.8 ± 12.6
18-30 years	18 (18.0)
31-45 years	38 (38.0)
46-60 years	30 (30.0)
>60 years	14 (14.0)
Male	42 (42.0)
Female	58 (58.0)
BMI, kg/m²	26.4 ± 4.3
Normal BMI	31 (31.0)
Overweight	46 (46.0)
Obese	23 (23.0)
Hypertension	34 (34.0)
Type 2 diabetes mellitus	28 (28.0)
Dyslipidemia	46 (46.0)

Note. BMI, body mass index; SD, standard deviation.

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Thyroid dysfunction was identified in 38.0% of participants, while 62.0% were euthyroid. Subclinical hypothyroidism was the most common abnormality (20.0%), followed by overt hypothyroidism (10.0%), subclinical hyperthyroidism (5.0%), and overt hyperthyroidism (3.0%). Thyroid dysfunction was more frequent among females than males (46.6% vs. 26.2%). The binary association between sex and total thyroid dysfunction was statistically significant ($\chi^2(1)=4.28$, $p=0.039$) (Table 2).

Table 2. Pattern of thyroid function status among study participants according to sex

Thyroid function status	Total n (%)	Male (n=42)	Female (n=58)
Euthyroid	62 (62.0)	31 (73.8)	31 (53.4)
Subclinical hypothyroidism	20 (20.0)	6 (14.3)	14 (24.1)
Overt hypothyroidism	10 (10.0)	3 (7.1)	7 (12.1)
Subclinical hyperthyroidism	5 (5.0)	1 (2.4)	4 (6.9)
Overt hyperthyroidism	3 (3.0)	1 (2.4)	2 (3.4)
Total thyroid dysfunction	38 (38.0)	11 (26.2)	27 (46.6)

Note. Pearson chi-square for total thyroid dysfunction versus euthyroid by sex: $\chi^2(1)=4.28$, $p=0.039$.

Participants with thyroid dysfunction had significantly higher BMI, waist circumference, fasting plasma glucose, HbA1c, total cholesterol, triglycerides, and LDL cholesterol compared with euthyroid participants. HDL cholesterol was lower among participants with thyroid dysfunction. These differences indicate an adverse metabolic profile among adults with abnormal thyroid function (Table 3).

Table 3. Comparison of metabolic parameters between euthyroid participants and participants with thyroid dysfunction

Metabolic parameter	Euthyroid (n=62)	Thyroid dysfunction (n=38)	p-value
BMI, kg/m²	25.3 ± 3.8	28.1 ± 4.5	0.002
Waist circumference, cm	86.8 ± 9.6	94.2 ± 11.1	0.001
Fasting plasma glucose, mg/dL	104.6 ± 26.8	125.2 ± 37.4	0.004
HbA1c, %	5.9 ± 0.8	6.5 ± 1.1	0.006
Total cholesterol, mg/dL	178.4 ± 34.6	207.8 ± 42.5	<0.001
Triglycerides, mg/dL	142.6 ± 52.4	181.9 ± 61.8	0.001
LDL cholesterol, mg/dL	104.8 ± 28.7	130.6 ± 35.4	<0.001
HDL cholesterol, mg/dL	45.6 ± 8.9	40.8 ± 7.6	0.007

Note. Values are presented as mean ± SD. The independent sample t-test was used for group comparisons.

Metabolic syndrome was present in 38.0% of the overall study population. It was significantly more frequent among participants with thyroid dysfunction than among euthyroid participants. Among adults with thyroid dysfunction, 23 of 38 participants had metabolic syndrome, compared with 15 of 62 euthyroid participants (60.5% vs. 24.2%; $\chi^2(1)=13.20$, $p<0.001$) (Table 4).

Table 4. Association of thyroid dysfunction with metabolic syndrome

Thyroid status	Metabolic syndrome present n (%)	Metabolic syndrome absent n (%)	Total n (%)
Euthyroid	15 (24.2)	47 (75.8)	62 (100.0)
Thyroid dysfunction	23 (60.5)	15 (39.5)	38 (100.0)
Total	38 (38.0)	62 (62.0)	100 (100.0)

Note. Pearson chi-square test: $\chi^2(1)=13.20$, $p<0.001$. No cells have been left blank.

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Correlation analysis showed that TSH had a positive correlation with BMI, waist circumference, fasting plasma glucose, HbA1c, total cholesterol, triglycerides, and LDL cholesterol. A negative correlation was observed between TSH and HDL cholesterol (Table 5).

Table 5. Correlation of TSH with metabolic parameters

Correlation pair	Correlation coefficient	p-value
TSH vs BMI	r = 0.32	0.001
TSH vs waist circumference	r = 0.35	<0.001
TSH vs fasting plasma glucose	r = 0.28	0.005
TSH vs HbA1c	r = 0.26	0.009
TSH vs total cholesterol	r = 0.41	<0.001
TSH vs triglycerides	r = 0.37	<0.001
TSH vs LDL cholesterol	r = 0.39	<0.001
TSH vs HDL cholesterol	r = -0.24	0.016

Note. Pearson correlation was used. TSH, thyroid-stimulating hormone.

Overall, thyroid dysfunction was observed in more than one-third of adults attending the General Medicine clinic. Subclinical hypothyroidism was the predominant abnormality. Thyroid dysfunction was significantly associated with increased adiposity, impaired glycemic status, dyslipidemia, and metabolic syndrome.

Discussion

In this cross-sectional outpatient study, thyroid dysfunction was detected in 38.0% of adults, with subclinical hypothyroidism forming the largest subgroup. This finding indicates that biochemical thyroid abnormalities are not uncommon in General Medicine practice, particularly in a clinic population enriched with metabolic complaints. The observed pattern is compatible with Indian data showing hypothyroidism as a frequent endocrine condition in adults, although the proportion in the present study is higher than many community estimates because the sample was hospital-based [1,2].

Female participants showed a greater burden of thyroid dysfunction than males, and the binary comparison of thyroid dysfunction with euthyroid status was statistically significant. This sex difference has been reported in large epidemiological studies and may reflect the higher background susceptibility of women to autoimmune thyroid disease and subclinical thyroid abnormalities [3,4]. In a routine outpatient setting, the finding is useful because symptoms of early thyroid disease may be vague and can overlap with fatigue, weight change, menstrual disturbance, constipation, or poor cardiometabolic control.

The metabolic profile of participants with thyroid dysfunction was clearly less favorable. They had higher BMI, larger waist circumference, higher fasting plasma glucose, and higher HbA1c than euthyroid adults. The positive correlations of TSH with adiposity and glycemic variables support a graded thyroid-metabolic relationship in this sample. Thyroid hormones influence energy expenditure, insulin sensitivity, and adipocyte function; however, the cross-sectional design means that reverse pathways, including the effect of obesity and inflammation on the hypothalamic-pituitary-thyroid axis, cannot be excluded [5,6].

Dyslipidemia was another important signal in the study. Total cholesterol, triglycerides, and LDL cholesterol were higher among adults with thyroid dysfunction, whereas HDL cholesterol was lower. These observations agree with the established role of thyroid hormones in hepatic LDL receptor expression, cholesterol removal, bile acid synthesis, and triglyceride handling [7,8]. Previous reports have shown strong lipid disturbances in overt hypothyroidism and milder but clinically relevant changes in subclinical hypothyroidism [9-11]. The present correlation findings further support careful lipid assessment in patients with elevated TSH.

Metabolic syndrome was more frequent in participants with thyroid dysfunction than in euthyroid adults. This association is clinically meaningful because metabolic syndrome represents the clustering of central obesity, dysglycemia, hypertension, and atherogenic lipid changes, all of which increase future cardiovascular and diabetes risk [12]. Similar findings have been described among patients with metabolic syndrome and among Indian adults with diabetes or hypertension [13,14]. The present results therefore support an integrated approach in General Medicine clinics, where thyroid testing may be particularly useful in adults with obesity, dyslipidemia, diabetes

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mellitus, hypertension, or multiple metabolic syndrome components.

Generalizability

The findings may be applicable to adults attending similar government General Medicine outpatient clinics in semi-urban Indian settings, especially where metabolic disorders are commonly managed. However, extrapolation to community populations, endocrine specialty centers, or geographically different regions should be cautious because this was a single-center, clinic-based study with a modest sample size.

Conclusion

Thyroid dysfunction was frequent among adults attending the General Medicine clinic, with subclinical hypothyroidism as the leading abnormality. Adults with thyroid dysfunction showed higher adiposity, poorer glycemic indices, adverse lipid profiles, and greater metabolic syndrome burden than euthyroid adults. Increasing TSH levels correlated positively with BMI, waist circumference, fasting glucose, HbA1c, total cholesterol, triglycerides, and LDL cholesterol, while HDL cholesterol showed an inverse relationship. These findings support routine thyroid evaluation in adults with obesity, dyslipidemia, diabetes mellitus, hypertension, or metabolic syndrome. Early identification may improve risk stratification and guide comprehensive outpatient metabolic care.

Limitations

This study had a single-center design and a modest sample size, limiting wider generalizability. The cross-sectional design did not establish temporal or causal relationships between thyroid dysfunction and metabolic abnormalities. Thyroid antibody status, dietary iodine intake, medication adherence, and long-term cardiovascular outcomes were not assessed. Selection from a General Medicine clinic also introduced outpatient referral bias.

Recommendations

Routine thyroid function screening should be considered in adults presenting with obesity, central adiposity, impaired glucose regulation, dyslipidemia, hypertension, or features of metabolic syndrome in General Medicine outpatient settings. Patients with subclinical hypothyroidism should undergo periodic follow-up, as early metabolic changes may precede overt clinical disease. Integrated evaluation of thyroid status with BMI, waist circumference, fasting plasma glucose, HbA1c, and lipid profile may help identify individuals at increased cardiometabolic risk. Lifestyle modification, weight control, dietary counselling, and timely referral for endocrine evaluation should be encouraged. Larger multicenter studies are recommended to confirm these findings and improve population-level applicability.

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Abbreviations

BMI: Body mass index
CKD: Chronic kidney disease
FPG: Fasting plasma glucose
HbA1c: Glycated haemoglobin
HDL: High-density lipoprotein
LDL: Low-density lipoprotein
TSH: Thyroid-stimulating hormone
T3: Triiodothyronine
T4: Thyroxine
T2DM: Type 2 diabetes mellitus

Data availability

The data are available on reasonable request.

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The study did not receive any funding from public, commercial, or not-for-profit funding agencies.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

Dr Saraswathi Banavath contributed to study conception, study design, clinical supervision, patient recruitment, data collection, interpretation of findings, manuscript drafting, critical revision, and final approval of the manuscript.
Dr B. Chandra Mohan contributed to patient screening, data verification, analysis support, interpretation of metabolic and thyroid profile findings, literature review, and manuscript revision.

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Dr Praveen Kumar Kavuri contributed to data collection, clinical assessment, biochemical data organization, literature review, statistical interpretation, manuscript preparation, and revision of the intellectual content.

Author biography

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