International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 2, February 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.2.2025.4

ORIGINAL RESEARCH

Prevalence And Clinical Implications Of Thyroid Function Abnormalities In Adult Patients With Type 2 Diabetes

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Received: 22 December, 2024 Accepted: 15 January, 2025 Published: 03 February, 2025

ABSTRACT

Background: Thyroid dysfunction (TD) and Type 2 Diabetes Mellitus (T2DM) are two common endocrinopathies that frequently coexist. Hypothyroidism, whether overt or subclinical, may exacerbate insulin resistance and worsen glycemic control. On the other hand, hyperthyroidism can increase gluconeogenesis and reduce insulin sensitivity, also leading to glycemic instability. Despite these known interactions, routine screening for thyroid dysfunction among adult T2DM patients remains suboptimal, and there is a lack of robust data on its prevalence and association with diabetic complications.

Methods: In this cross-sectional observational study, 166 adult T2DM patients aged >35 years attending the Outpatient Department and Inpatient Department of the School of Tropical Medicine, Kolkata, were enrolled. After obtaining informed consent, demographic profiles, anthropometric data (BMI), and clinical history were recorded. Biochemical tests included fasting and postprandial plasma glucose, HbA1c, thyroid hormone panels (T3, T4, FT4, TSH), lipid profile, and urine albumin-to-creatinine ratio (ACR). Diabetic complications such as retinopathy, neuropathy, and nephropathy were evaluated, and statistical analysis was performed to determine associations.

Results: Overall, 24.69% of T2DM patients had thyroid dysfunction. Among them, 23.49% had hypothyroidism (overt or subclinical) and 1.20% had hyperthyroidism (overt or subclinical). Thyroid dysfunction was more common in females (31.25%) than in males (18.60%). A significant association was noted between thyroid dysfunction and obesity (p=0.0006), poor glycemic control (p=0.009), dyslipidemia (p=0.01), albuminuria (p=0.02), and diabetic retinopathy (p=0.01). Neuropathy and hypertension showed no statistically significant difference with respect to thyroid status.

Conclusion: Our study underscores a high prevalence of thyroid dysfunction in adult T2DM patients. Hypothyroidism, in particular, was strongly associated with overweight/obesity, dyslipidemia, and microvascular complications. Early screening and prompt management of thyroid dysfunction may improve glycemic control and possibly reduce the risk of diabetic complications.

Keywords: Type 2 Diabetes Mellitus, Thyroid Dysfunction, Hypothyroidism, Hyperthyroidism, Prevalence, Diabetic Complications

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a major health concern worldwide, characterized by insulin resistance and relative insulin deficiency. The prevalence of T2DM has been rising steadily, partly due to lifestyle changes and an increase in obesity [1]. Thyroid disorders, another frequently encountered endocrine condition, may remain undiagnosed for long periods because their onset can be insidious [2]. The intricate relationship between insulin and thyroid hormones is well known, as thyroid hormones can influence glucose metabolism, and conversely, insulin resistance can affect thyroid function [3].

In the context of T2DM, hypothyroidism is generally associated with a reduction in glucose disposal, often compounding the underlying insulin resistance [4]. The American Thyroid Association advocates screening for thyroid disorders, particularly among high-risk

DOI: 10.69605/ijlbpr_14.2.2025.4

individuals such as those with T2DM, who often have multiple metabolic comorbidities [5]. Furthermore, some studies suggest that subclinical hypothyroidism may be linked to worsening cardiovascular risk profiles, including dyslipidemia and diastolic hypertension, which are also prevalent in patients with T2DM [6]. Early recognition and appropriate treatment of thyroid dysfunction can therefore be critical in mitigating cardiovascular and microvascular complications.

Despite these pathophysiological links, thyroid function is not routinely assessed in many centers when evaluating patients with T2DM [7]. Studies have estimated varying prevalence rates of thyroid dysfunction in T2DM, ranging from 10% to 20% in different populations [8]. These discrepancies highlight the influence of geographic, genetic, and environmental factors, as well as differences in screening strategies. Given this variability, it is crucial to generate region-specific data and investigate possible associations between thyroid dysfunction and the microvascular and macrovascular complications of T2DM.

In addition to the potential for aggravating insulin resistance, thyroid dysfunction may exacerbate other metabolic problems, including dyslipidemia. Overt hypothyroidism is particularly notorious for elevating LDL cholesterol levels, while overt hyperthyroidism often elevates total T3 levels and can hasten the development of diabetic complications [4,5]. Furthermore, microvascular complications such as nephropathy and retinopathy have been reported to be more frequent when thyroid dysfunction coexists with T2DM [6].

This study aims to determine the prevalence of thyroid abnormalities among adult T2DM patients in a tertiary-care setting in Kolkata and to explore the association of thyroid dysfunction with diabetic complications. A detailed evaluation of anthropometric factors, glycemic control, and comorbid conditions such as dyslipidemia and hypertension was also undertaken. By shedding light on these relationships, the study may provide insights that emphasize the importance of early detection and timely management of thyroid dysfunction in patients with T2DM.

MATERIALS AND METHODS

Study Setting and Population

This cross-sectional observational study was conducted at the In-Patient Department of Carmichael Hospital for Tropical Diseases and the Out-Patient Departments of Tropical Medicine and Endocrine, Nutrition & Metabolic Diseases at the School of Tropical Medicine, Kolkata, from July 2021 to June 2022. Patients aged >35 years with diagnosed T2DM who provided written informed consent were included. Individuals with Type 1 DM, MODY, pregnancy, acute febrile illness, or on drugs affecting thyroid function (other than standard oral hypoglycemic agents or thyroid medications) were excluded.

Sample Size

Based on an anticipated thyroid dysfunction prevalence of 17.5% in T2DM [reference from thesis: 15], with an absolute precision of 5% and 5% level of significance, and a finite population correction for about 650 new patients per year, a final sample size of 166 was calculated using Cochran's formula.

Data Collection

A pre-designed proforma was used to record demographic data (age, sex), clinical history (family history of diabetes or thyroid disease, duration of diabetes, presence of hypertension, etc.), and physical examination findings (BMI, blood pressure, acanthosis nigricans, signs of thyroid enlargement). Laboratory investigations included:

- Fasting and postprandial plasma glucose, HbA1c
- Serum T3, T4, FT4, TSH
- Lipid profile (total cholesterol, LDL, HDL, and triglycerides)
- Kidney function tests (urea, creatinine), urine albumin-to-creatinine ratio (ACR)
- Other routine hematological parameters

Diabetic complications were assessed through direct ophthalmoscopy for retinopathy, monofilament testing for neuropathy, and urine ACR for nephropathy. ECG and echocardiography were performed to assess cardiac status. Goiter or enlarged thyroid gland was recorded if clinically appreciable.

Definitions and Reference Values

- **Euthyroid:** TSH 0.35–5.50 mIU/L, Free T4 = 0.9–2.0 ng/dL
- **Overt hypothyroidism:** Elevated TSH with low T4/FT4
- **Subclinical hypothyroidism:** Elevated TSH with normal T4/FT4
- **Overt hyperthyroidism:** Suppressed TSH with elevated T3/T4/FT4
- **Subclinical hyperthyroidism:** Suppressed TSH with normal T3/T4/FT4
- **Dyslipidemia:** Elevated LDL (>100 mg/dL), elevated TG (>150 mg/dL), or total cholesterol >200 mg/dL
- **Poorly controlled diabetes:** HbA1c >7%
- **Albuminuria:** Urinary ACR ≥30 mg/g

Statistical Analysis

Continuous variables (e.g., age, BMI, HbA1c) were expressed as mean ± standard deviation (SD). Independent t-test was used to compare means between two groups. Categorical variables (e.g., presence of

DOI: 10.69605/ijlbpr_14.2.2025.4

thyroid dysfunction, hypertension, dyslipidemia, diabetic complications) were expressed as percentages and analyzed using the Chi-square test. A p-value <0.05 was considered statistically significant.

Ethics

Approval was obtained from the Clinical Research Ethics Committee, School of Tropical Medicine (CRE-STM). Written informed consent was provided by all participants or a legal representative. Confidentiality was maintained, and clinical management was not altered by participation in this study.

RESULTS

General Findings

In total, 166 adult T2DM patients were evaluated. The mean age was 51.09 ± 8.99 years, with the majority (51.8%) in the 35–50-year age group. Males accounted for 51.8% and females for 48.2%. The mean duration of diabetes was 6.33 ± 3.12 years. Family history of diabetes was noted in 54.82%.

Overweight and obesity were frequent. The mean BMI was 24.36 ± 1.67 kg/m², with 53% overweight and 29% obese by WHO Asian classification. Acanthosis nigricans, indicative of insulin resistance, was present in 45.78% of patients.

Prevalence of Thyroid Dysfunction

Overall, 24.69% (n=41) had thyroid dysfunction. Of these, 23.49% were hypothyroid (13.25% overt, 10.24% subclinical), while 1.20% were hyperthyroid (0.60% overt, 0.60% subclinical). Hypothyroidism was more common in females (64.1% of hypothyroid participants). Among those with thyroid dysfunction, 43.75% were obese (BMI ≥25 kg/m²), which was statistically significant (p=0.0006).

Glycemic Control and Thyroid Status

The overall mean HbA1c was 7.49 ± 1.39%. A higher mean HbA1c was observed in subclinical (8.13 ± 1.75%) and overt hypothyroid patients (7.9 ± 1.47%) compared to euthyroid subjects (7.34 ± 1.29%). Thyroid dysfunction prevalence among poorly controlled diabetics (HbA1c >7%) was 32.32%, showing a statistically significant association (p=0.009).

Dyslipidemia

Dyslipidemia was present in 65.06% of the study population, with elevated LDL and triglycerides being the most common abnormalities. Among those with thyroid dysfunction, 82.92% had dyslipidemia (p=0.01).

Diabetic Nephropathy (Albuminuria)

Albuminuria was observed in 27.71% of participants (19.87% microalbuminuria, 7.83% macroalbuminuria). Among these, 32.6% were hypothyroid. The association between albuminuria and thyroid dysfunction was statistically significant (p=0.02).

Diabetic Retinopathy

Diabetic retinopathy was present in 16.26% (n=27). Mild NPDR was the most common (9.64%), followed by moderate NPDR (6.02%). Among these 27 patients, 44.44% had thyroid dysfunction—predominantly hypothyroidism (p=0.01).

Hypertension and Neuropathy

Hypertension was found in 78.31% of patients but showed no significant difference between euthyroid and thyroid dysfunction groups (p=0.96). Distal symmetrical polyneuropathy was present in 50.60% of subjects, with a higher numeric prevalence among hypothyroid subjects but not reaching statistical significance (p=0.17).

Selected Tables and Figures

Table 1. Prevalence Of Thyroid Dysfunction In T2dm (N=166)

Thyroid Status	Number (%)
Euthyroid	125 (75.31)
Overt Hypothyroidism	22 (13.25)
Subclinical Hypothyroid	17 (10.24)
Overt Hyperthyroidism	1 (0.60)
Subclinical Hyperthyroid	1 (0.60)

Table 2. Association Of Thyroid Dysfunction With Obesity

Group	BMI ≥25 (Obese/Overweight)	BMI <25 (Normal)	Total	p-value
Thyroid Dysfunction	21 (43.75%)	20 (16.94%)	41	0.0006
Euthyroid	27 (56.25%)	98 (83.06%)	125	

DOI: 10.69605/ijlbpr_14.2.2025.4

Figure 1. Prevalence Of Thyroid Dysfunction

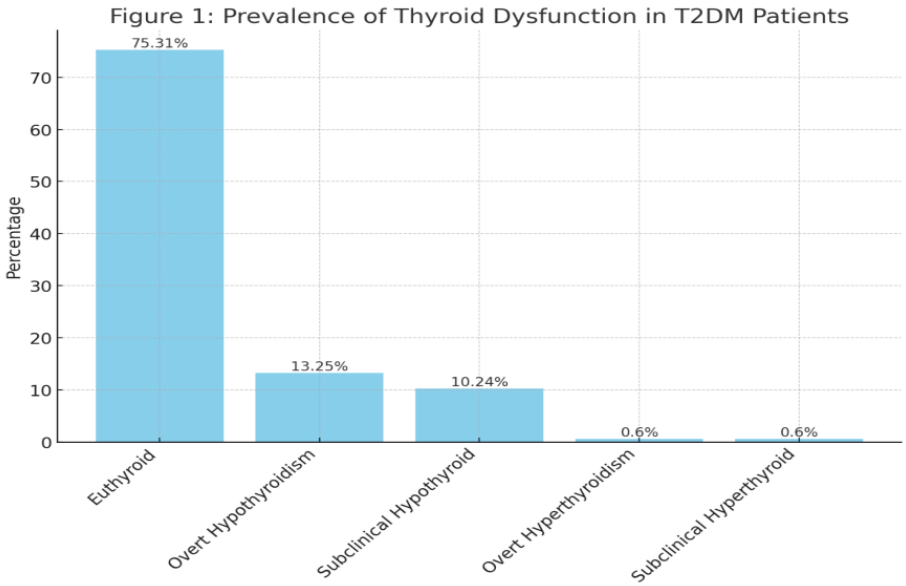
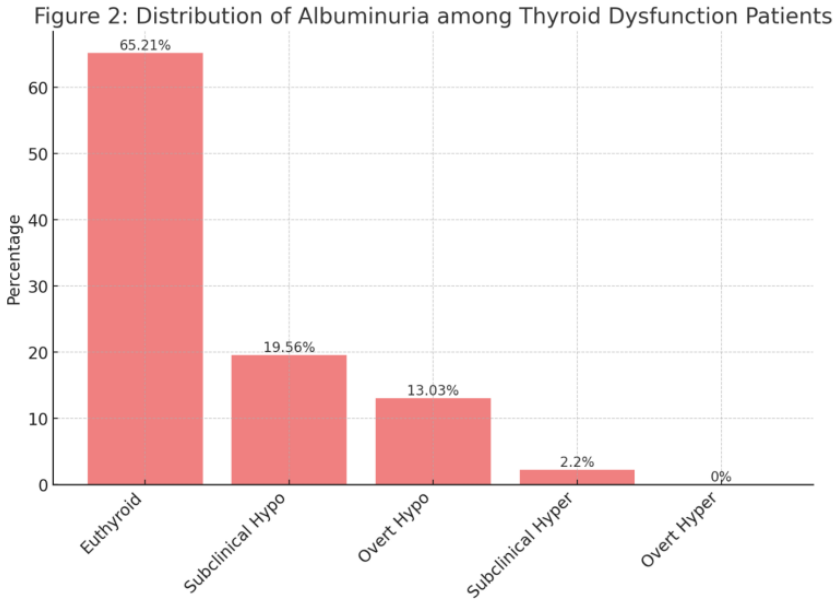


Figure 2. Distribution Of Albuminuria Among Thyroid Dysfunction Patients



DISCUSSION

In this cross-sectional study, thyroid dysfunction was found in approximately one-quarter of adult T2DM patients. This prevalence aligns with previous research indicating that 10% to 20% of diabetic patients may have coexisting thyroid disorders, although our slightly higher figure underscores regional and population-specific variations [9]. The predominance of hypothyroidism over hyperthyroidism has also been noted in similar studies, reinforcing the greater clinical burden posed by reduced thyroid hormone levels in patients with insulin resistance [10].

One notable finding was the significantly higher prevalence of thyroid dysfunction in female patients. Women have an increased risk of developing autoimmune thyroid disease and subclinical hypothyroidism, which could partly explain these results [11]. Our data also revealed a strong association between thyroid dysfunction and poor glycemic control ($p=0.009$). Hypothyroidism can exacerbate insulin resistance, making it more challenging to achieve optimal glycemic targets [12]. In particular, subclinical hypothyroidism appeared to have a meaningful impact on metabolic control, highlighting the importance of

DOI: 10.69605/ijlbpr_14.2.2025.4

detecting even mild thyroid hormone imbalances in T2DM.

Dyslipidemia, especially elevated LDL and triglycerides, was found in the majority of thyroid dysfunction patients. This observation concurs with previous reports that hypothyroidism, both overt and subclinical, can contribute to atherogenic lipid profiles [13]. These lipid abnormalities amplify cardiovascular risk, which is already high in T2DM. The statistically significant correlation (p=0.01) signals the need for integrated management of both lipid and thyroid abnormalities to attenuate cardiovascular complications.

Microvascular complications such as nephropathy (albuminuria) and retinopathy were also seen more often in patients with thyroid dysfunction. Elevated TSH levels and low T4 are hypothesized to decrease renal perfusion and worsen endothelial dysfunction, thus potentiating nephropathy [14]. Additionally, the higher incidence of retinopathy in hypothyroid individuals in our study (44.44% among retinopathy cases, p=0.01) aligns with data suggesting that thyroid hormones may influence retinal microcirculation [15].

Although we observed a numeric trend toward more frequent neuropathy in hypothyroid participants, it was not statistically significant (p=0.17). Similarly, hypertension prevalence did not differ significantly between thyroid dysfunction and euthyroid groups, possibly reflecting the fact that hypertension in T2DM is multifactorial and not solely driven by thyroid hormone status [16]. The limited sample size for some subgroups may also have constrained our ability to detect significant differences.

Overall, our findings underscore the importance of routine screening for thyroid dysfunction in adult T2DM patients, particularly those who exhibit poor glycemic control, obesity, dyslipidemia, and signs of microvascular complications. Early detection and appropriate treatment may improve metabolic outcomes, reduce complication rates, and enhance quality of life. Future larger, longitudinal studies will be essential for confirming these results and evaluating the long-term impact of thyroid hormone optimization on macrovascular events such as myocardial infarction or stroke [17].

CONCLUSION

In conclusion, this cross-sectional study found that nearly one in four adult patients with T2DM has thyroid dysfunction, with hypothyroidism (both overt and subclinical) being most prevalent. Thyroid abnormalities were significantly associated with obesity, dyslipidemia, albuminuria, and retinopathy, as well as poorer glycemic control. These findings highlight the importance of systematic screening for thyroid dysfunction among adult T2DM patients, especially women and those with inadequate glycemic control or microvascular complications. Early detection and management of thyroid disorders could favorably influence metabolic control, potentially mitigating the burden of T2DM-related complications and improving overall patient outcomes.

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