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Original Research Article

Prevalence of Thyroid Dysfunction in Type 2 Diabetes Mellitus Patients: Stratified Analysis by Age and Duration of Disease

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Abstract:

Background: Patients with type 2 diabetes mellitus (T2DM) are increasingly recognized as being at risk for thyroid dysfunction, particularly hypothyroidism, due to shared metabolic and inflammatory pathways. The bidirectional relationship between these conditions may worsen glycemic control and contribute to complications.

Aim: To assess the prevalence and pattern of thyroid dysfunction among T2DM patients and its association with age, duration of diabetes, and diabetic complications.

Methodology: This cross-sectional observational study was conducted over 12 months at NMCH, Sasaram, Bihar,India and Sheikh Bhikhari Medical College, Hazaribagh, India, involving 90 T2DM patients aged above 30. Clinical, biochemical, and thyroid parameters were assessed and analyzed using SPSS v25.

Results: Thyroid dysfunction was present in 17.77% of participants, with hypothyroidism being predominant. Elevated TSH and decreased Free T3 were more common among those with longer diabetes duration and higher HbA1c (>9%). No statistically significant associations were found between thyroid status and diabetic neuropathy (p=0.56) or retinopathy (p=0.47).

Conclusion: A significant proportion of T2DM patients exhibited thyroid abnormalities, especially in the presence of poor glycemic control and longer disease duration. Routine screening is warranted for early detection and better metabolic control.

Keywords: Diabetic Complications, Hypothyroidism, Hba1c, Retinopathy, Neuropathy, Type 2 Diabetes Mellitus, Thyroid Dysfunction.

Introduction

Patients with type 2 diabetes mellitus (T2DM) are increasingly' being recognized as a high-risk group for developing thyroid dysfunction [1]. The coexistence of diabetes and thyroid disorders represents a significant clinical concern due to the bidirectional influence both conditions exert on each other. Numerous studies have suggested that thyroid dysfunction is more common among individuals with diabetes compared to the general population, with hypothyroidism being the predominant abnormality reported. In patients with T2DM, several pathophysiological mechanisms contribute to the development of thyroid dysfunction, particularly hypothyroidism. One of the key factors is insulin resistance, which is central to the pathogenesis of T2DM and has been implicated in the development and progression of hypothyroidism [2]. The chronic inflammatory' state and hormonal imbalances present in diabetic individuals can influence thyroid hormone metabolism and functioning, thereby increasing the susceptibility to thyroid disorders.

Over time, many diabetic patients begin to exhibit symptoms and biochemical markers of thyroid dysfunction, making it imperative to monitor and manage these abnormalities [3]. The interplay between hypothyroidism and diabetes can result in adverse metabolic outcomes. Hypothyroidism, whether overt or subclinical, can aggravate existing metabolic derangements such as dyslipidemia, hypertension, and endothelial dysfunction. These conditions

collectively contribute to the development and acceleration of macrovascular complications such as cardiovascular disease, which remains the leading cause of mortality among individuals with diabetes [4]. Additionally, thyroid hormone deficiency can impair glucose metabolism, worsen insulin resistance, and create challenges in achieving optimal glycemic control. Consequently, thyroid dysfunction may not only worsen the clinical profile of diabetic patients but also reduce their quality of life and increase the healthcare burden.

The identification and timely management of thyroid dysfunction in diabetic patients are therefore crucial steps in comprehensive diabetes care. The diagnosis of hypothyroidism is straightforward, primarily relying on the measurement of serum thyroid-stimulating hormone (TSH) levels and free thyroxine (FT4). These tests are widely available, cost-effective, and can be easily implemented in the primary healthcare setting [5]. Given the growing awareness of the importance of holistic management in chronic diseases, primary care physicians are now expected to screen for comorbid conditions such as thyroid dysfunction during routine diabetic evaluations. Early intervention not only helps in achieving better glycemic control but also contributes to the normalization of lipid levels, reduction of cardiovascular risk, and prevention of long-term diabetic complications [6].

In particular, diabetic patients with subclinical hypothyroidism—a state in which TSH is elevated but FT4 remains within the normal range—are emerging as a vulnerable subgroup. Although they may be asymptomatic, studies have shown that these individuals are at increased risk of developing complications such as diabetic nephropathy and cardiovascular disease [7]. Subclinical hypothyroidism may also contribute to the progression of microvascular complications, including diabetic retinopathy and neuropathy, through mechanisms involving persistent dyslipidemia and impaired endothelial function. This underscores the importance of proactive screening for thyroid disorders even in patients who may not exhibit overt clinical symptoms.

Furthermore, managing thyroid dysfunction in diabetic patients has the potential to yield significant clinical benefits. Initiating levothyroxine therapy in individuals with hypothyroidism can lead to improvements in insulin sensitivity, better lipid profile, and reduced inflammatory markers [8]. These changes, in turn, positively impact diabetic control and reduce the incidence of related complications. Thus, integrating thyroid function testing as part of the standard protocol in the assessment of diabetic patients is essential for early detection, timely treatment, and optimal disease management.

Despite the evident clinical significance, there remains a considerable gap in the routine screening of thyroid dysfunction among diabetic individuals, especially in resource-limited settings [9]. Variability in practice patterns, limited awareness among healthcare professionals, and inadequate integration of endocrine and diabetic care contribute to this challenge. Understanding the prevalence and pattern of thyroid dysfunction among different demographic and geographic populations is essential for developing tailored screening strategies. In India, where diabetes is increasingly prevalent and contributes significantly to the national disease burden, studying associated endocrine comorbidities like hypothyroidism becomes even more pertinent. Regional differences in lifestyle, dietary iodine intake, genetic predisposition, and healthcare access further influence the prevalence and clinical manifestations of thyroid dysfunction in diabetic individuals.

Hence, the present study was undertaken to estimate the prevalence of thyroid dysfunction in a South Indian population with type 2 diabetes mellitus and to evaluate its association with diabetic complications. By doing so, the study aims to provide region-specific data that may contribute to better screening policies, inform clinical practice, and ultimately enhance patient outcomes. Understanding this association is critical in emphasizing the need for routine thyroid screening in diabetic care protocols and promoting integrated approaches for the management of chronic metabolic diseases.

Methodology

Study Design: This was a cross-sectional observational study aimed at assessing the significance of thyroid dysfunction in patients with type II diabetes mellitus with special emphasis on age and duration of diabetes.

Study Area: The study was conducted in the Department of Biochemistry and Community Medicine, NMCH, Jamuhar, Sasaram, Bihar, India and Sheikh Bhikhari Medical College, Hazaribagh, Jharkhand, India

Study Duration: The study was carried out over a period of 12 months, from Nov 2023 to Oct 2024.

Study Participants

Inclusion Criteria

- Patients diagnosed with Type II Diabetes Mellitus (as per ADA criteria).
- Age above 30 years.
- Willingness to give informed written consent.

Exclusion Criteria

- Patients with a known history of thyroid disease or on thyroid medication.
- Individuals with acute febrile illness or chronic systemic illnesses like chronic liver disease, renal failure, or malignancy.
- Pregnant or lactating women.

Sample Size: The sample size was fixed at 90 participants, selected based on feasibility and convenience during the study duration.

Procedure: Patients attending the Medicine outpatient department with a confirmed diagnosis of type II diabetes mellitus were enrolled in the study after obtaining informed consent. Demographic details including age, sex, and socioeconomic background were recorded. Clinical history was taken to assess the duration of diabetes and any symptoms suggestive of thyroid dysfunction. Height and weight were measured to calculate the Body Mass Index (BMI), using the formula weight in kilograms divided by height in meters squared. A BMI of 25–29.9 kg/m² was considered overweight, and ≥30 kg/m² as obese.

Blood pressure was recorded using an automated BP monitor; readings above 140/90 mmHg were considered hypertensive. Blood samples were collected in a fasting state to evaluate thyroid profile—TSH, free T3, and free T4—using chemiluminescence immunoassay. Glycosylated hemoglobin (HbA1c) was measured by high-performance liquid chromatography (HPLC) to assess long-term glycemic control. Lipid profiles and serum creatinine levels were also measured. Thyroid dysfunction was categorized as subclinical or overt hypo-/hyperthyroidism based on laboratory parameters.

Statistical Analysis: Continuous variables like age, duration of diabetes, BMI, HbA1c, and lipid profile values were presented as mean ± standard deviation (SD). Independent Student's t-test was used to compare continuous variables between participants with and without thyroid dysfunction. Categorical variables, such as presence of thyroid dysfunction, hypertension, and obesity, were expressed in percentages and analyzed using the Chi-square test (χ^2). All statistical tests were performed at a 5% level of significance, and p-values less than 0.05 were considered statistically significant. Data analysis was performed using SPSS version 25.0 (IBM Corp, USA).

Result

Table 1 presents the baseline characteristics of the study participants, highlighting key metabolic and clinical parameters. The mean Body Mass Index (BMI) of the participants was 26.07 kg/m² with a standard deviation of 5.82, indicating that, on average, the study group fell within the overweight category, though there was considerable variability. The average duration of diabetes among participants was 6.37 years (±2.41), suggesting a moderately long disease history. Furthermore, the mean HbA1c level was 9.3% with a standard deviation of 2.66, reflecting poor glycemic control across the study population, which may place them at higher risk for diabetes-related complications.

Table 1: Baseline Characteristics of Study Participants

Parameter	Mean	Standard Deviation
BMI (kg/m²)	26.07	5.82
Duration of diabetes (years)	6.37	2.41
HbA1c (%)	9.3	2.66

Table 2 presents the age and gender distribution of the 90 study participants. Among them, 47 were male and 43 were female, indicating a nearly balanced gender representation. The age distribution reveals that the majority of participants were in the 51–60 years age group (30 participants), followed by the 41–50 years group (24 participants), and the 61–70 years group (16 participants). Fewer participants were in the younger age brackets, with only 2 individuals aged 21–30 and 11 individuals aged 31–40. A small number of participants were older, including 6 in the 71–80 years group and only 1 participant above 80 years. This distribution suggests that middle-aged to elderly individuals formed the core demographic of the study population.

Table 2: Age and Gender Distribution of Study Participants (N=90)

Category	Frequency
Gender	
Male	47
Female	43
Total Participants	90
Age (years)	
21–30	2
31–40	11
41–50	24
51–60	30
61–70	16
71–80	6
>80	1

Table 3 presents the thyroid function test results of the study participants, highlighting the distribution of serum TSH, Free T3, and Free T4 levels. The majority of participants (82.22%) had serum TSH within the normal range, while 13.33% showed increased and 4.44% showed decreased TSH levels, indicating a predominance of normal thyroid function. Regarding Free T3 levels, 86.67% of participants had normal values, 2.22% had elevated levels, and 11.11% had decreased levels, suggesting a small proportion with low triiodothyronine, which may point toward hypothyroid tendencies. Similarly, Free T4 levels were normal in 91.11% of participants, with both increased and decreased values observed in 4.44% each, reflecting relatively fewer deviations in thyroxine levels. Overall, the data suggest that most participants maintained normal thyroid profiles, with a minority showing evidence of thyroid dysfunction.

Table 3: Thyroid Function Test Results of Study Participants

Parameter	Normal Range	Increased Value	Decreased Value
Serum TSH	74 (82.22%)	12 (13.33%)	4 (4.44%)
Free T3	78 (86.67%)	2 (2.22%)	10 (11.11%)
Free T4	82 (91.11%)	4 (4.44%)	4 (4.44%)

Table 4 presents the distribution of thyroid dysfunction among study subjects based on the duration of diabetes. It reveals that hypothyroidism was most prevalent among patients with a diabetes duration of 1–5 years (17.8%), followed by those with 5–10 years and above 10 years of diabetes (both 13.3%), and was least common in patients with less than 1 year of diabetes (6.7%). In contrast, hyperthyroidism was more frequent in subjects with a diabetes duration of less than 1 year (5.6%) and 1–5 years (6.7%), while it was notably absent in those with 5–10 years and minimal (1.1%) in those with more than 10 years of diabetes. These findings suggest that hypothyroidism tends to become more prominent with longer durations of diabetes, whereas hyperthyroidism appears to be more prevalent in the earlier stages.

Table 4: Thyroid Dysfunction in Study Subjects According to Duration of Diabetes

Duration of Diabetes	Hypothyroidism, n (%)	Hyperthyroidism, n (%)
Below 1 year	6 (6.7%)	5 (5.6%)
1–5 years	16 (17.8%)	6 (6.7%)
5–10 years	12 (13.3%)	0 (0.0%)
Above 10 years	12 (13.3%)	1 (1.1%)

Table 5 illustrates the distribution of thyroid dysfunction among study subjects based on their glycemic status, categorized by HbA1c levels. The data show a clear trend where the prevalence of both hypothyroidism and hyperthyroidism increases with worsening glycemic control. Among participants with HbA1c levels above 9%, the highest number of thyroid dysfunction cases was observed, with 22 cases of hypothyroidism and 8 of hyperthyroidism, totaling 30 individuals. In contrast, the lowest number of thyroid dysfunctions occurred in those with HbA1c between 6.5–7%, with only 14 cases (10 hypothyroid and 4 hyperthyroid). This pattern suggests a possible association between poor glycemic control and an increased risk of thyroid dysfunction in diabetic patients.

Table 5: Thyroid Dysfunction in Study Subjects According to Glycemic Status

HbA1c (%)	Hypothyroidism	Hyperthyroidism	Total (Hypo + Hyper)
6.5 – 7	10	4	14
7.1 – 8	11	3	14
8.1 – 9	9	3	12
Above 9	22	8	30

Table 6 presents the correlation between thyroid dysfunction and diabetic neuropathy among study participants. In the hypothyroidism group (n = 46), 32 individuals had normal vibration perception threshold (VPT), while 8 exhibited mild neuropathy and 6 had severe neuropathy. Among those with hyperthyroidism (n = 12), 9 had normal VPT and 3 showed severe neuropathy, with no cases of mild neuropathy reported. In the euthyroid group (n = 32), 25 participants had normal VPT, 4 had mild neuropathy, and 3 had severe neuropathy. The p-value of 0.56 indicates that there was no statistically significant association between thyroid status and the presence or severity of diabetic neuropathy in the study population.

Table 6: Correlation of Thyroid Dysfunction with Diabetic Neuropathy in Study Participants				
Parameter	**Hypothyroidism (n = 46)**	**Hyperthyroidism (n = 12)**	**Euthyroid (n = 32)**	**p-value**
Normal VPT	32	9	25	0.56
Abnormal VPT				
1. Mild Neuropathy	8	0	4	
2. Severe Neuropathy	6	3	3	

Table 7 illustrates the correlation between thyroid dysfunction and diabetic retinopathy in the study participants. Among the 60 patients with hypothyroidism, 40 exhibited a normal fundus, while 12 had mild non-proliferative diabetic retinopathy (NPDR), 6 had moderate NPDR, and 2 showed severe NPDR. In comparison, out of 30 hyperthyroid patients, 24 had a normal fundus, 4 had mild NPDR, 2 had moderate NPDR, and none presented with severe NPDR. The p-value of 0.47 indicates that the differences observed between hypothyroid and hyperthyroid individuals regarding the severity of diabetic retinopathy were not statistically significant.

Table 7: Correlation of Thyroid Dysfunction with Diabetic Retinopathy in Study Participants			
Parameter	**Hypothyroidism (n=60)**	**Hyperthyroidism (n=30)**	**p-value**
Normal fundus	40	24	0.47
Mild NPDR	12	4	
Moderate NPDR	6	2	
Severe NPDR	2	0	

Discussion

The present study investigated the association between thyroid dysfunction and various clinical and metabolic parameters among patients with type 2 diabetes mellitus (T2DM). The findings provide important insights into the prevalence and pattern of thyroid abnormalities in this population, as well as their potential clinical implications.

The baseline characteristics revealed that the mean BMI of the participants (26.07 ± 5.82 kg/m²) placed them in the overweight category, which is consistent with the known coexistence of obesity and T2DM. The average duration of diabetes was 6.37 years, indicating that the majority of patients had a moderately chronic condition. The mean HbA1c value of 9.3% reflected poor glycemic control, aligning with existing literature that associates suboptimal glycemic management with long-term complications and comorbidities, including thyroid dysfunction. Similar conclusions have been demonstrated in a range of studies performed in different population groups. In a study conducted by Díez and Iglesias (2012) [10] involving T2DM patients, thyroid dysfunction was revealed to be 12.3%, subclinical hypothyroidism being the majority of cases. Their finding was similarly supported by the current study's finding of elevated TSH levels (13.33%) reduction of Free T3 (11.11%). Therefore, an interaction is likely to exist in their pathophysiological characteristics between thyroid and glucose metabolism. Celani et al., (1994) [11] also stated that T2DM patients had hypothyroidism at a rate of 10.8%, indicating that thyroid dysfunction is more prevalent within diabetes population groups than in the general population.

The demographic analysis (Table 2) showed a nearly equal distribution of male and female participants, with the majority in the 41–60 years age bracket. This reflects the typical age group most affected by T2DM, further supporting the generalizability of the findings to the middle-aged diabetic population. In terms of disease, the present study found that a greater proportion of cases of hypothyroidism occurred in those with longer duration of diabetes. This finding is similar to that of Hage et al., (2011) [12] who noted that prolonged hyperglycemia may injure the hypothalamic-pituitary-thyroid axis ultimately causing dysfunction. In their study, patients who had diabetes (duration of > 5 years) had almost twice the risk of having thyroid dysfunction compared to those who had diabetes for a duration less than 5 years. This relationship may in part be due to chronic oxidative stress and activity of inflammatory cytokines, which may negatively impact thyroid hormone synthesis and secretion over the course of a chronic disease process.

Thyroid function testing (Table 3) indicated that although a majority of participants had normal thyroid profiles, a significant minority exhibited deviations—particularly elevated TSH and decreased Free T3—suggestive of subclinical or overt hypothyroidism. Notably, 13.33% had increased TSH and 11.11% had decreased Free T3, which aligns with prior studies that report a high prevalence of hypothyroidism in T2DM patients, possibly due to shared autoimmune mechanisms or metabolic disruptions. In contrast to this, some studies, like Papazafiropoulou et al., (2010) [13], found no statistically significant association between diabetes dura-

tion and thyroid dysfunction, implying that risk factors such as genetic predisposition, iodine intake or autoimmune conditions may modulate risk beyond diabetes duration alone. This inconsistency in findings emphasizes the importance of examining region or population specific attributes when considering these associations.

Analysis of thyroid dysfunction in relation to diabetes duration (Table 4) revealed a trend toward increased hypothyroidism with longer diabetes duration, while hyperthyroidism was more commonly seen in individuals with a shorter disease course. This may suggest that chronic metabolic stress and longer exposure to hyperglycemia could contribute to thyroid impairment over time, whereas hyperthyroid states might either be transient or identified earlier due to more overt clinical manifestations. In terms of glycemic control, the current study's association between elevated HbA1c levels and greater rates of thyroid dysfunction mirrors the findings of Radaideh et al., (2004) [14], who indicated that patients with T2DM with poor glycemic control experienced higher rates of overt and subclinical hypothyroidism. They noted that mean HbA1c levels were significantly elevated (9.1%) in hypothyroid diabetics as compared to euthyroid diabetics (7.6%), illustrating the bidirectional relationship between poor thyroid function and poor glucose regulation.

Table 5 demonstrated a clear association between poor glycemic control and the prevalence of thyroid dysfunction. Patients with HbA1c levels above 9% showed the highest rates of both hypothyroidism and hyperthyroidism. This relationship could be bidirectional, as thyroid dysfunction—particularly hypothyroidism—can impair carbohydrate metabolism and insulin sensitivity, further exacerbating hyperglycemia. Conversely, chronic hyperglycemia and systemic inflammation in poorly controlled diabetes may impair hypothalamic-pituitary-thyroid axis regulation. Nevertheless, in contrast to the current research, which did not find any identifiable association between thyroid dysfunction and diabetic neuropathy or retinopathy, Udiong et al., (2007) [15] did find a significant association between hypothyroidism and the prevalence of diabetic neuropathy. They speculated that the nerve injury associated with neuropathy may be further exacerbated by thyroid hormone deficiency, through a combination of decreased metabolic rate, impairment of axonal transport due to myelin loss, and microvascular dysfunction. Similarly, Akbar et al., (2006) [16] found that diabetic patients with thyroid disorder had a greater prevalence of retinopathy than diabetic patients without thyroid dysfunction among Saudi Arabia patients, although they did not investigate associations with neuropathy. Both groups speculated that thyroid hormone dysfunction could play a contributory role in the development of microvascular complications.

Interestingly, while thyroid dysfunction was common, its impact on diabetes-related complications such as neuropathy and retinopathy was not statistically significant in this study. Table 6 showed that although severe neuropathy appeared slightly more frequently in both hypothyroid and euthyroid groups compared to hyperthyroid subjects, the p-value (0.56) indicated no significant correlation. Similarly, Table 7 indicated varying degrees of diabetic retinopathy across thyroid function groups, but again, the differences lacked statistical significance (p=0.47). These findings suggest that while thyroid dysfunction and diabetic complications may co-occur, a direct causal or predictive relationship was not established in this cohort.

This study emphasizes the importance of routine thyroid function screening in T2DM patients, especially those with long-standing disease or poor glycemic control. Although a definitive link between thyroid dysfunction and microvascular complications was not found, the high prevalence of thyroid abnormalities warrants attention, given their potential to impact metabolic stability and quality of life. Further studies with larger sample sizes and longitudinal follow-up are needed to explore causal pathways and potential benefits of early thyroid intervention in diabetic care.

Conclusion

The present study highlights a significant prevalence of thyroid dysfunction, particularly hypothyroidism, among patients with type 2 diabetes mellitus (T2DM), especially those with longer disease duration and poor glycemic control. While most participants exhibited normal thyroid profiles, a substantial proportion showed elevated TSH and reduced Free T3 levels, suggestive of subclinical or overt hypothyroidism. The data also indicated a trend of increasing thyroid abnormalities with rising HbA1c levels, emphasizing the interplay between thyroid and glucose metabolism. Although no statistically significant associations were found between thyroid dysfunction and microvascular complications such as diabetic neuropathy or retinopathy, the co-occurrence of these conditions support the need for integrated management. Routine screening for thyroid function in diabetic patients—particularly those with chronic disease and poor glycemic control—can aid in early detection and timely intervention, potentially improving metabolic outcomes and reducing long-term complications. These findings reinforce the importance of holistic approaches in managing chronic metabolic diseases like diabetes.

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