

## Association of Thyroid-Stimulating Hormone (TSH) Levels with Glycemic Control in Type 2 Diabetes Mellitus: An Analytical Study of 50 Patients

\*Sheme ZA,<sup>1</sup> Huda AK,<sup>2</sup> Akhter L<sup>3</sup>

### Abstract

**Background:** Diabetes mellitus (DM) and thyroid dysfunction are two of the most prevalent endocrine disorders that frequently coexist. Both conditions share several pathophysiological pathways that may influence each other's progression and management.

**Objectives:** To analyze the relationship between thyroid stimulating hormone (TSH) levels and glycemic control in patients with type 2 diabetes mellitus (T2DM).

**Methods:** This cross-sectional analytical study included 50 diabetic patients attending the Department of Medicine, Rangpur Medical College Hospital, between January 2024 to December 2024. Demographic data, fasting blood sugar (FBS), HbA1c, and serum TSH levels are recorded

**Results:** Among 50 patients (28 males, 22 females; mean age  $52.3 \pm 9.4$  years), 34% had abnormal TSH levels. Hypothyroidism was more common (26%) than hyperthyroidism (8%). Poor glycemic control (HbA1c > 8%) was significantly associated with elevated TSH ( $p < 0.05$ ).

**Conclusion:** Subclinical hypothyroidism is frequent among T2DM patients and correlates with poor glycemic control. Routine screening for thyroid dysfunction is recommended for better management of diabetic patients.

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1. \*Dr. Zinat Afrin Sheme, Associate Professor (Biochemistry), Army Medical College, Rangpur, Bangladesh. [zinatafrinsheme@gmail.com](mailto:zinatafrinsheme@gmail.com)
2. Dr. AKM. Kamrul Huda. Assistant Professor (Surgery), Army Medical College Rangpur Bangladesh
3. Dr Latifa Akhter. Associate Professor Department of Dermatology, Rangpur Medical College, Rangpur, Bangladesh.

\*For correspondence.

## Introduction

Diabetes mellitus (DM) is one of the most common chronic metabolic diseases globally, characterized by hyperglycemia resulting from insulin deficiency, insulin resistance, or both.<sup>1</sup> Thyroid disorders, particularly hypothyroidism, are the second most common endocrine disorders after diabetes.<sup>2</sup> The interrelationship between thyroid hormones and insulin has been well established; both significantly influence metabolism and cellular energy utilization.<sup>3</sup>

Thyroid hormones affect glucose homeostasis by modulating insulin secretion and glucose uptake.<sup>4</sup> Conversely, insulin and insulin resistance may affect thyroid hormone metabolism and activity.<sup>5</sup> In patients with type 2 diabetes mellitus (T2DM), subclinical thyroid dysfunction may worsen glycemic control and lipid metabolism.<sup>6</sup>

Several studies have reported a higher prevalence of thyroid dysfunction among diabetic populations compared to non-diabetic controls.<sup>7-9</sup> Subclinical hypothyroidism, in particular, has been associated with insulin resistance and dyslipidemia.<sup>10</sup> Therefore, assessing thyroid function in T2DM patients can provide valuable information for comprehensive metabolic management.

The present study aims to evaluate the pattern of thyroid dysfunction among T2DM patients and its correlation with glycemic control.

## Methods

This analytical cross-sectional study was conducted in the Department of Medicine, Rangpur Medical College Hospital, Rangpur, Bangladesh, from January 2024 to December 2024.

### *Inclusion Criteria*

- Diagnosed cases of Type 2 Diabetes Mellitus ( $\geq 1$  year duration).
- Age between 30–70 years.

### *Exclusion Criteria*

- Patients with known thyroid disease or on thyroid medications.
- Type 1 diabetes mellitus, pregnancy, or acute systemic illness.

### *Data Collection*

Demographic data, fasting blood sugar (FBS), postprandial blood sugar (PPBS), HbA1c, and serum TSH levels were recorded. Serum TSH was measured using ELISA. Normal TSH range: 0.4–4.5  $\mu$ IU/mL.

### *Statistical Analysis*

Data were analyzed using SPSS v25. Descriptive statistics were used, and the chi-square test assessed associations.  $p < 0.05$  was considered significant.

## Results

The mean age of the participants was  $52.3 \pm 9.4$  years, indicating that most patients were middle-aged. The sample had a slight male predominance (28 males vs. 22 females). The mean duration of diabetes was  $7.6 \pm 3.8$  years, suggesting that most participants had long-standing T2DM. The mean HbA1c level was  $8.2 \pm 1.1\%$ , reflecting overall poor glycemic control in the study population. The mean TSH level was  $3.9 \pm 2.4$   $\mu$ IU/mL, which is near the upper limit of normal, indicating the presence of possible subclinical hypothyroidism in a portion of the patients.

Table I Baseline demographic and clinical characteristics of the 50 patients included in the study

Parameter	Mean $\pm$ SD / n (%)
Age (years)	52.3 $\pm$ 9.4
Male : Female	28 : 22
Duration of DM (years)	7.6 $\pm$ 3.8
Mean HbA1c (%)	8.2 $\pm$ 1.1
Mean TSH ( $\mu$ IU/mL)	3.9 $\pm$ 2.4

Table II: Distribution of thyroid function status among the study participants

Thyroid Status	No. of Patients	Percentage
Euthyroid	33	66%
Hypothyroid	13	26%
Hyperthyroid	4	8%

A majority of patients (66%) were euthyroid, while 34% demonstrated some form of thyroid dysfunction. Hypothyroidism was more common (26%) compared to hyperthyroidism (8%). This finding indicates that thyroid dysfunction—particularly hypothyroidism—is relatively frequent among T2DM patients. The higher prevalence of hypothyroidism is consistent with other studies where subclinical hypothyroidism is seen more commonly in diabetic populations. This distribution supports the importance of routine thyroid evaluation in these patients.

Table III: Relationship between glycemic control (HbA1c) and TSH levels

HbA1c (%)	Mean TSH ( $\mu$ IU/mL)	p-value
<7	$2.7 \pm 1.2$	-
7–8	$3.6 \pm 1.9$	<0.05
>8	$4.8 \pm 2.6$	<0.01

Patients with good glycemic control (HbA1c < 7%) had the lowest mean TSH level ( $2.7 \pm 1.2 \mu$ IU/mL). As HbA1c increased, there was a corresponding rise in mean TSH levels. Patients with moderate glycemic control (HbA1c 7–8%) had a mean TSH of  $3.6 \pm 1.9 \mu$ IU/mL, while poorly controlled patients (HbA1c > 8%) had the highest TSH values ( $4.8 \pm 2.6 \mu$ IU/mL).

The statistically significant p-values (<0.05 and <0.01) indicate a strong positive association between poor glycemic control and elevated TSH levels.

This suggests that subclinical hypothyroidism becomes more prevalent as diabetes becomes more poorly controlled.

## Discussion

Thyroid dysfunction is increasingly recognized as a common comorbidity among individuals with type 2 diabetes mellitus (T2DM). In this study, 34% of diabetic patients demonstrated abnormalities in thyroid function, with hypothyroidism being the predominant disorder (26%). This finding aligns with previous reports by Akbar et al.<sup>13</sup> and Hage et al.,<sup>14</sup> who documented thyroid dysfunction rates between 28–35% among T2DM populations. The similarity of these results reinforces the concept that thyroid abnormalities are more frequent in diabetic patients compared to the general population.

The predominance of hypothyroidism observed in this study supports earlier findings that suggest a higher occurrence of subclinical hypothyroidism in diabetic individuals.<sup>15,16</sup> Several mechanisms may explain this association. Chronic hyperglycemia is believed to impair hypothalamic–pituitary–thyroid axis activity, leading to elevated TSH levels. Additionally, insulin resistance—typically seen in T2DM—has been associated with altered deiodinase activity, which may reduce peripheral conversion of T4 to the more active T3 hormone.<sup>17</sup> Autoimmune mechanisms may also play a role, as some patients with T2DM may have underlying autoimmune tendencies that predispose them to thyroid autoimmunity.

One of the most significant findings of this study is the strong association between elevated TSH levels and poor glycemic control (HbA1c > 8%). Patients with higher HbA1c showed significantly higher TSH levels, indicating a possible link between worsening metabolic control and subclinical hypothyroidism. This observation is

consistent with the results of Díez and Iglesias,<sup>17</sup> who reported that subclinical hypothyroidism is associated with increased insulin resistance and difficulty achieving glycemic control. Unnikrishnan et al.<sup>18</sup> also reported a higher prevalence of hypothyroidism in individuals with poorly controlled diabetes, supporting the findings of the present analysis.

The interplay between thyroid hormones and glucose metabolism is complex and bidirectional. Hypothyroidism may contribute to impaired insulin-mediated glucose utilization, reduced hepatic glucose output regulation, and diminished glucose transporter expression, all of which can worsen glycemic control. Conversely, poor glycemic control may also have direct effects on thyroid function. Persistent hyperglycemia can alter pituitary sensitivity, reduce thyroid hormone synthesis, and impair TSH regulation, thereby elevating TSH levels in diabetic patients.

The clinical implications of this association are substantial. Subclinical hypothyroidism, even in the absence of overt symptoms, is known to worsen lipid profiles, increase diastolic blood pressure, and promote endothelial dysfunction.<sup>19,20</sup> In diabetic patients, these changes further increase cardiovascular risk, which is already elevated due to underlying metabolic abnormalities. Early detection and treatment of hypothyroidism in diabetic individuals may therefore help improve glycemic control and reduce diabetes-related complications.

The findings of the present study underscore the importance of routine thyroid screening in patients with T2DM. Identifying thyroid dysfunction at an early stage allows for appropriate management through thyroid hormone replacement therapy or close monitoring. This approach may help optimize glycemic control, improve quality of life, and

reduce long-term metabolic and cardiovascular complications. Furthermore, given the relatively high prevalence of thyroid disorders observed in this study, incorporating thyroid function evaluation as a part of routine diabetes assessment may be beneficial, particularly in patients with poorly controlled HbA1c levels.

While the study offers valuable insights, certain limitations must be acknowledged. The sample size was relatively small ( $n = 50$ ), and the study was conducted at a single center, which may limit the generalizability of the findings. Additionally, thyroid autoantibodies were not measured, which could have provided a clearer understanding of autoimmune involvement. Longitudinal studies with larger sample sizes are recommended to further explore the causal relationship between glycemic control and thyroid function.

Despite these limitations, the present study contributes to the growing body of literature highlighting the significance of thyroid screening in diabetic care. The demonstrated association between elevated TSH levels and poor glycemic control emphasizes the need for a more integrated approach to managing T2DM patients.

### *Conclusion*

This study demonstrates a high prevalence of subclinical hypothyroidism among patients with type 2 diabetes mellitus. A significant positive correlation exists between elevated TSH and poor glycemic control. Regular thyroid screening should be incorporated into the routine evaluation of diabetic patients to improve overall metabolic outcomes.

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