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Correlation between Thyroid Dysfunction and Glycemic Status in Type 2 Diabetic Patients

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ABSTRACT

Background: Thyroid dysfunction (TD) is frequently observed in patients with type 2 diabetes mellitus (T2DM) and may influence glycemic control. Despite growing evidence globally, data from Bangladesh remain limited. ***Objective:*** To evaluate the prevalence of thyroid dysfunction and its association with glycemic and clinical parameters among T2DM patients attending a tertiary care hospital. ***Materials and Methods*:** A cross-sectional observational study was conducted from January to December 2025 in 120 T2DM patients at Jalalabad Ragib-Rabeya Medical College, Sylhet. Patients with type 1 diabetes, known thyroid disease, pregnancy, acute illness, or use of drugs affecting thyroid function were excluded. Demographic and clinical data, including age, sex, duration of diabetes, BMI, and blood pressure, were collected. Fasting blood glucose, 2-hour postprandial glucose, HbA1c, serum creatinine, FT3, FT4, and TSH were measured. TD was defined by abnormal thyroid hormone levels (FT3, FT4, TSH). Data were analyzed using t-tests, Chi-square tests, and Pearson's correlation, with $p < 0.05$ considered significant. ***Results*:** TD was observed in 50% of patients, more frequent in males (61.7%) than females (38.3%). Hypothyroidism (38.3%) predominated over hyperthyroidism (11.7%). T2DM patients with TD had significantly higher TSH levels (7.27 ± 5.25 vs 2.31 ± 1.48 μIU/mL; $p < 0.001$), while other biochemical parameters were comparable. HbA1c positively correlated with TSH ($r = 0.307$; $p = 0.001$). ***Conclusion:*** Thyroid dysfunction is common among T2DM patients and is associated with poor glycemic control. Routine thyroid screening may aid in better diabetes management.

Keywords: Type 2 Diabetes Mellitus, Thyroid Dysfunction, Hba1c, TSH, Glycemic Control.

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INTRODUCTION

Thyroid dysfunction (TD) is widely reported to be more prevalent among patients with type 2 diabetes mellitus (T2DM) across different regions of the world; however, data from the local context remain limited. A recent hospital-based study from Bangladesh demonstrated a considerable burden of thyroid dysfunction among patients with T2DM attending a tertiary care center, emphasizing the need for further regional research to clarify this association [1]. Similar

observations have been reported in studies from Iran and other countries, suggesting that thyroid disorders frequently coexist with T2DM irrespective of geographic variation [2]. Thyroid disorders and diabetes mellitus are among the most common endocrine diseases worldwide and represent major public health challenges due to their chronic course and potential for serious complications [3]. The development of T2DM is multifactorial, involving complex interactions between genetic, epigenetic, and environmental factors [4]. The global burden of T2DM is increasing at an alarming rate, with projections estimating 643 million affected individuals by 2030 and 783 million by 2045 [5, 6]. Type 2 diabetes accounts for approximately 95% of all diabetes cases and significantly increases the risk of adverse health outcomes, particularly in individuals with associated metabolic comorbidities [7]. Growing evidence suggests a close relationship between thyroid function and glycemic control. Studies have demonstrated significant correlations between glycosylated hemoglobin (HbA1c) levels and thyroid hormones, indicating that thyroid status may influence long-term glycemic regulation in patients with T2DM [8]. Diabetes and thyroid disorders mutually affect each other due to their shared endocrine regulatory mechanisms. Even minor variations in thyroid hormone levels within the normal range may contribute to insulin resistance and the development or progression of T2DM, although findings remain inconsistent across studies [9]. The thyroid gland consists of follicles responsible for the synthesis and storage of thyroid hormones. The hypothalamus secretes thyrotropin-releasing hormone (TRH), which stimulates the anterior pituitary to release thyroid-stimulating hormone (TSH). TSH acts on thyroid follicular cells to promote the secretion of thyroxine (T4), accounting for approximately 80%, and triiodothyronine (T3), accounting for about 20% of circulating thyroid hormones. Thyroid hormone synthesis depends on adequate iodide supply, TSH stimulation, and tyrosine residues on thyroglobulin. Peripheral conversion of T4 to the biologically active T3 occurs via deiodination, and circulating thyroid hormones regulate their own production through a negative feedback mechanism on TSH secretion [10]. Thyroid dysfunction encompasses a spectrum of disorders characterized by abnormal serum levels of T3, T4, and TSH. These conditions may present as hypothyroidism, hyperthyroidism, thyroid enlargement, or subclinical disease without overt clinical manifestations [11]. Thyroid hormones play a crucial role in glucose metabolism, and both hypothyroidism and hyperthyroidism are associated with increased insulin resistance and poor glycemic control. Diabetes may alter TSH secretion and peripheral conversion of thyroid hormones, leading to hyperinsulinemia and thyroid tissue proliferation [12]. Dysregulation of the hypothalamic-pituitary-thyroid axis has also been proposed as a contributing mechanism to abnormal thyroid hormone levels in patients with T2DM [13]. In hypothyroidism, reduced thyroid hormone levels impair pancreatic β-cell function, decrease intestinal glucose absorption, and reduce peripheral glucose uptake due to increased insulin resistance and decreased insulin sensitivity. These metabolic disturbances further aggravate hyperglycemia in patients with T2DM [9]. Given these bidirectional interactions, routine screening for thyroid dysfunction in patients with diabetes is recommended. Early diagnosis and appropriate management may improve insulin sensitivity, enhance glycemic control, and reduce the risk of microvascular and macrovascular complications [14]. Therefore, the present study aims to evaluate the association between thyroid dysfunction and glycemic status in patients with type 2 diabetes mellitus attending a tertiary care hospital.

MATERIALS AND METHODS

A cross-sectional observational hospital-based study was conducted in the Department of Biochemistry, Jalalabad Ragib-Rabeya Medical College, Sylhet, from January 2025 to December 2025 among 120 admitted patients with type 2 diabetes mellitus (T2DM) who met the inclusion criteria. All patients with T2DM, regardless of blood pressure, glycemic control, or treatment modality (oral hypoglycemic agents or insulin), were included. Patients with type 1 diabetes, known thyroid disorders, history of neck trauma or surgery, prior radiation exposure to the neck, pregnancy or postpartum status, acute illnesses affecting thyroid function, hemoglobinopathies, anemia, gestational diabetes, pancreatitis, steroid-induced diabetes, or current use of drugs affecting thyroid function (amiodarone, lithium, interferon-alpha, iodides, beta-blockers, carbimazole, propylthiouracil, potassium iodide, Lugol's iodine) were excluded. Demographic data (age, sex), anthropometric measurements (height, weight, body mass index [BMI]), and blood pressure readings (systolic and diastolic) were recorded. Clinical information, including the duration of

diabetes and family history of diabetes or thyroid disorders, was documented. Venous blood samples (5 mL) were collected in the morning after an overnight fast to measure fasting blood glucose (FBG), fasting lipid profile, glycated hemoglobin (HbA1c), free triiodothyronine (FT3), free thyroxine (FT4), and thyroid-stimulating hormone (TSH). An additional 5 mL sample was collected for two-hour postprandial plasma glucose (2HPPG) and serum creatinine measurement. Blood glucose levels were determined using enzymatic methods, while HbA1c was measured using high-performance liquid chromatography (HPLC). Serum FT3, FT4, and TSH concentrations were estimated using chemiluminescence immunoassay (CLIA). Thyroid dysfunction (TD) was diagnosed when hormone levels fell outside reference ranges: FT3 (2.3–4.2 pg/mL), FT4 (0.89–1.76 ng/mL), and TSH (0.35–5.55 μIU/mL). Quantitative variables were expressed as mean ± standard deviation (SD) and compared using the unpaired t-test. Qualitative variables were presented as frequencies and percentages, with intergroup comparisons performed using the Chi-square test. Pearson's correlation coefficient was employed to assess the relationship between thyroid dysfunction and clinical or biochemical parameters in T2DM patients. A p-value of less than 0.05 was considered statistically significant throughout the analysis.

RESULTS

Table 1: Distribution of Thyroid Dysfunction in T2DM According to age and Sex (n = 120)

Demographic profile	**Study group**		**Total**	**p-value**
Age (years)	**T2DM with TD n (%)**	**T2DM without TD n (%)**		
20–30	0 (0.0%)	1 (1.7%)	1	
31–40	6 (10.0%)	9 (15.0%)	15	
41–50	24 (40.0%)	14 (23.3%)	38	
>50	30 (50.0%)	36 (60.0%)	66	0.49
Gender				
Male	37 (61.7%)	23 (38.3%)	60	
Female	23 (38.3%)	37 (61.7%)	60	0.19
Total	60 (50.0%)	60 (50.0%)	120	

TD = **Thyroid Dysfunction**

Table 2: Distribution of Thyroid Dysfunction According to Duration of Diabetes (Years) (n = 120)

Duration of Diabetes (yrs)	**T2DM with TD n (%)**	**T2DM without TD n (%)**	**Total**	**p-value**
0–4	13 (21.7%)	28 (46.67%)	35	0.03
5–9	33 (55.0%)	21 (35.0%)	60	
10–12	10 (16.7%)	8 (13.3%)	18	
>12	4 (6.6%)	3 (5.0%)	7	
Total	**60 (50.0%)**	**60 (50.0%)**	**120**	

In this study of 120 T2DM patients, thyroid dysfunction (TD) was most observed in patients with a diabetes duration of 5–9 years (55.0%), followed by 0–4 years (21.7%), 10–12 years (16.7%), and >12 years (6.6%). The association between diabetes duration and TD was statistically significant (p = 0.03), indicating that TD prevalence varied meaningfully with the length of diabetes.

Table 3: Prevalence of Type of Thyroid Disorder According to Gender in T2DM (N = 120)

Sex	Thyroid status			Total	p-value
	Euthyroidism n (%)	Hypothyroidism n (%)	Hyperthyroidism n (%)		
Male	32 (53.3%)	28 (46.7%)	9 (15.0%)	69	
Female	28 (46.7%)	18 (30.0%)	5 (8.3%)	51	0.63
Total	60 (50.0%)	46 (38.3%)	14 (11.7%)	120	

Among the 120 patients with T2DM, euthyroidism was the most common thyroid status (50.0%), followed by hypothyroidism (38.3%) and hyperthyroidism (11.7%). Hypothyroidism was more frequent in males than females (46.7% vs 30.0%), while hyperthyroidism was also slightly higher among males (15.0% vs 8.3%). However, the gender-wise distribution of thyroid disorders did not show a statistically significant difference (p = 0.63).

Table 4: Comparison of Various Biochemical Parameters in T2DM With and Without Thyroid Dysfunction (N = 120)

Parameter	T2DM with TD (n = 60) Mean ± SD	T2DM without TD (n = 60) Mean ± SD	t-value	p-value
FBG (mg/dl)	10.62 ± 3.42	10.52 ± 3.74	0.213	0.832
2HPPG (mg/dl)	14.31 ± 4.26	13.73 ± 4.12	0.921	0.358
HbA1c (%)	8.21 ± 1.73	8.44 ± 2.29	−0.631	0.529
S. Creatinine (mg/dl)	1.18 ± 0.91	1.13 ± 0.31	1.510	0.132
TSH (µIU/L)	**7.46 ± 4.95**	**2.43 ± 1.71**	-7.440	**<0.001***
FT4 (ng/ml)	0.871 ± 0.61	1.08 ± 0.76	−1.747	0.082
FT3 (pg/ml)	2.64 ± 1.23	2.57 ± 0.72	0.051	0.960

Patients with T2DM and thyroid dysfunction had significantly higher TSH levels compared to those without thyroid dysfunction (7.46 ± 4.95 vs 2.43 ± 1.71 µIU/L; p < 0.001). However, no statistically significant differences were observed between the two groups with respect to fasting blood glucose, 2-hour postprandial glucose, HbA1c, serum creatinine, FT4, or FT3 levels (p > 0.05 for all). This suggests that, apart from TSH, other biochemical and glycemic parameters were comparable between T2DM patients with and without thyroid dysfunction.

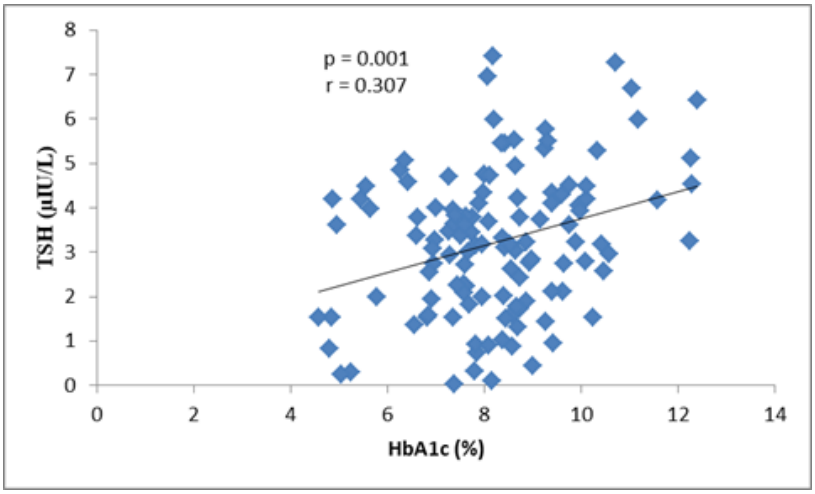

Figure 1: Scafler Diagram Showing the Correlation Between Hba1c and TSH in The Study Cases (R=0.307, P=0.03)

A moderate positive correlation was observed between HbA1c (%) and TSH (μIU/L) levels among the study participants (Pearson's r = 0.307), which was statistically significant (p = 0.001). This indicates that higher HbA1c levels were associated with increased TSH concentrations. The correlation remained significant at the 0.01 level, based on analysis of 120 subjects, suggesting a meaningful relationship between poor glycemic control and thyroid dysfunction.

DISCUSSION

The present study evaluated thyroid dysfunction among 120 patients with T2DM and assessed its relationship with demographic, clinical, and glycemic parameters. Thyroid dysfunction was observed in 50% of T2DM patients, with males showing a higher prevalence (61.7%) compared to females (38.3%). Conversely, euthyroidism was more frequent in females (61.7%). However, the gender difference was not statistically significant (p = 0.19). These findings are consistent with Chowdhury *et al*., who reported a TD prevalence of 25.6% in T2DM, with males slightly more affected than females, without significant gender difference [1]. Age-wise analysis revealed that TD was most commonly observed in patients over 50 years (50%), followed by the 41–50 year group (40%), with younger age groups showing lower prevalence. Similar patterns were reported by Chowdhury *et al*., although the association between age and TD was not statistically significant [1]. Song *et al*., also associated older age and female sex with an increased risk of hypothyroidism in T2DM patients [2].

Regarding the duration of diabetes, in this study of 120 T2DM patients, thyroid dysfunction (TD) was most observed in patients with a diabetes duration of 5–9 years (55.0%), followed by 0–4 years (21.7%), 10–12 years (16.7%), and >12 years (6.6%). The association between diabetes duration and TD was statistically significant (p = 0.03), indicating that TD prevalence varied meaningfully with the length of diabetes, consistent with Asuti *et al* [3]. In contrast, Pavalaveelzi *et al*., reported a positive association, with 76.2% of patients with diabetes longer than five years exhibiting TD, highlighting potential population and study-design differences [4]. Analysis of thyroid function parameters showed that T2DM patients with TD had significantly higher TSH levels than those without TD (7.46 ± 4.95 vs 2.43 ± 1.71 μIU/L; p < 0.001). No significant differences were observed for fasting blood glucose, 2-hour postprandial glucose, HbA1c, serum creatinine, FT4, or FT3 levels, suggesting that apart from TSH, other biochemical and glycemic parameters were comparable between groups. Catma *et al*., reported similar findings, with higher TSH and BMI in patients with TD compared to euthyroid T2DM patients, though fT3 levels were lower in TD [5]. Importantly, a moderate positive correlation between HbA1c and TSH (r = 0.307, p = 0.001) was observed, indicating that poor glycemic control is associated with elevated TSH levels. Similar correlations between HbA1c and TSH or FT3 have been reported by Karmakar *et al*. Elgazar *et al*., and Makandar *et al*., while no correlation was consistently observed with FT4 [6–9]. This reinforces the bidirectional relationship between thyroid function and glucose homeostasis [9,10]. The type distribution of TD in the present study showed hypothyroidism (38.3%) as more prevalent than hyperthyroidism (11.7%), consistent with previous reports indicating hypothyroidism as the predominant form in T2DM populations [1, 2, 12]. Gender-wise, hypothyroidism and hyperthyroidism were slightly more frequent in males, though differences were not statistically significant, reflecting similar patterns observed by Chowdhury *et al*., [1]. Overall, the findings support the need for routine thyroid function screening in T2DM patients, particularly those with poor glycemic control or longer disease duration. Early detection may improve diabetes management and reduce potential microvascular and macrovascular complications [9, 13, 14].

CONCLUSION

Thyroid dysfunction is common among patients with type 2 diabetes mellitus, affecting 50% of the study population. It was more frequent in males and in individuals over 50 years, though these differences were not statistically significant. Thyroid dysfunction was significantly associated with diabetes duration, particularly in patients with 5–9 years of disease. Patients with thyroid dysfunction had higher TSH levels, while other glycemic and biochemical parameters were similar to euthyroid patients. A moderate positive correlation between HbA1c and TSH suggests a link between poor glycemic control and thyroid dysfunction. Routine thyroid screening in T2DM is recommended.

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