Study of Thyroid Hormone Levels among Patients with Type 2 Diabetes Mellitus Attending a Tertiary Care Hospital of Chattogram, Bangladesh

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Abstract

Background: In diabetic individuals, undiagnosed thyroid function abnormalities may increase the risk of cardiovascular disease and affect metabolic management. Screening procedures, however, differ greatly, and there are no practical guidelines. The study aimed to find out the pattern and related factors of thyroid dysfunction in patients with Type-2 Diabetes Mellitus (T2DM) in a tertiary care hospital of Chattogram, Bangladesh, compared to the apparently healthy individuals.

Materials and methods: This comparative cross-sectional study compares, 50 diagnosed patients at Chittagong Medical College Hospital with T2DM were enrolled between January 2022 to December 2022 and 50 healthy individuals living in Chattogram City were selected as controls. Participants were screened for thyroid function test by estimating serum Thyroid Stimulating Hormone (TSH) Free Thyroxine (FT4) Free Tri-iodothyronine (FT3).

Results: The mean age of patients with T2DM was 45.5±6.2 years with a mean duration of diabetes of 5.2 ±1.6 years and 62% were female. Mean TSH level was higher in T2DM group contrasted to control group (3.51±0.42 vs. 2.47±0.23 µIU/ml, p=0.034). Mean serum FT3 and FT4 levels were similar in two groups (p=0.11 and p=0.56, respectively). Twelve (24%) of the patients with T2DM had thyroid function abnormalities (Overt hypothyroidism 6%, and subclinical hypothyroidism 18%) compared to 4% in the control group (p=0.013). Compared to non-T2DM subject, T2DM patients had 7.61 times higher chance of having thyroid function abnormalities (Odds ratio: 7.61, 95% confidence interval: 1.56-37.17, p=0.012). Duration of diabetes (r=0.388, p=0.005) and HbA1C levels (r=0.552, p=<0.001) had moderate positive correlation with serum TSH levels in patients with T2DM.

Conclusion: Patients having T2DM are at greatest threat of thyroid function abnormalities, mainly subclinical hypothyroidism, which calls for a methodical approach to thyroid testing in T2DM patients.

Key words: Endocrine illness; Type 2 Diabetes Mellitus; Thyroid dysfunction.

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Introduction

Among the chronic endocrine illnesses, T2DM is one of the most prevalent. A global pandemic of type 2 diabetes is being driven by rising obesity rates brought on by sedentary lifestyles and energy-rich diets.[1] Diabetes and thyroid problems (TDs) frequently coexist as another prevalent endocrinopathy.[2] A higher risk of acquiring Type 2 Diabetes (T2DM) particularly in the population with prediabetes, has been linked to decreased circulating levels of thyroid hormone, even when they are within normal reference amounts.[3]

Thyroid hormones regulate pancreatic function and the metabolism of carbohydrates; nevertheless, diabetes varies in its impact on thyroid function tests.[2] Thyroid issues and diabetes are related due to their autoimmune origin. These disorders are influenced by insulin, glucagon, and thyroid hormones, which impact carbohydrate metabolism. The presence of both TDs and T2DM can make it more challenging to maintain glycemic control.[4] Coexisting T2DM and thyroid disorder increase the likelihood of developing cardiovascular disease. Thyroid disorders can exacerbate T2DM, while diabetes can hamper thyroid function. Antithyroid drugs can affect glycemic control, while antidiabetic medications can affect thyroid function.[5] Considering the clinical significance of the

coexistence of T2DM and thyroid disorder, a more methodical approach is needed to assess thyroid function status in T2DM.

Bangladesh is a developing country facing continuous growth in the prevalence of T2DM[6]. It would be helpful to identify ways to reduce its incidence or complications.Thyroid dysfunction affects 10% to 30% of people with type 2 diabetes, and the relationship between T2DM and thyroid conditions has not been well studied in Bangladesh.[7-10] Hypothyroidism is more common than hyperthyroidism in patients with Type 2 Diabetes Mellitus (T2DM). Studies have shown that the prevalence of hypothyroidism, including both clinical and subclinical forms, is higher among T2DM patients compared to hyperthyroidism. For instance, one study found that the prevalence of hypothyroidism in T2DM patients was around 26.9%. At the same time, hyperthyroidism was less common.[11] In comparison to healthy individuals, the purpose of this study was to determine the pattern and contributing factors of thyroid function abnormalities in T2DM patients who visited a tertiary care hospital in Chattogram, Bangladesh. The study findings would provide greater insight into the relationship between T2DM and abnormal thyroid function.

Materials and methods

From June 2022 to May 2023, Chittagong Medical College and Hospital carried out a comparative cross-sectional study. The study's protocol was authorized by Chittagong Medical College's Ethical Review Committee. (Clearance certificate memo no. CMC/PG/2022/852, Date: 26/06/2023).

The study included 100 subjects aged between 30 to 55 years from the outpatient Department of Endocrinology. Fifty diagnosed T2DM patients were taken as cases, and 50 age-matched nondiabetic, apparently healthy individuals were taken as controls.Patients diagnosed with type 1 diabetes, those taking medications that could alter thyroid function (Such as lithium, amiodarone etc.) patients who had thyroid surgery, patients who were exposed to radiation on the thyroid gland, and patients with drug-induced hyperglycemia (Such as high dose steroids, pentamidine, diazoxide etc.) were not included in the study.

Using a structured proforma, participants' clinical and demographic information was gathered after they provided written informed consent.Venous blood (5 ml) was extracted using a disposal syringe from the anterior cubital vein while adhering to aseptic precautions. The blood was then transferred into a plain tube for measurement of HbA1c using High-Performance Liquid Chromatography and serum TSH, FT3, and FT4 by Chemiluminescence Immunoassay Method.

The SPSS-23 program was used to process and analyze data. Chi-square analysis was used to compare the groups for the qualitative variables, which were expressed as frequency (Percentage). Mean ±SD and range were the quantitative variables' expressions, and the difference between the two means was tested using an independent sample t-test. The independent impact of thyroid dysfunction on the presence of diabetes was assessed using binary logistic regression analysis. The effect size was reported as an Odds Ratio (OR) with a 95% Confidence Interval (CI) for the OR. The correlation between two quantitative variables was ascertained using Pearson correlation. A p-value of less than 0.05 was deemed statistically significant.

Results

The mean age of the T2DM patients was 45.5±6.2 years and ranged between 30-55 years. There was female preponderance among the diabetic patients with 62% female. In terms of gender distribution, Table I demonstrates that the diabetic and non-diabetic groups were similar; however, the mean age of T2DM patients was significantly higher in the diabetic group than in the non-diabetic group (p=0.018). In terms of their mean BMI, the non-diabetic and T2DM groups were comparable (p=0.186).

Table I Demographic characteristics of the diabetic and non-diabetic participants

Variables	T2DM (n=50)	Non-T2DM (n=50)	Test statistics	pvalue and significance
Age, years	45.5±6.2	42.2±7.3	t=2.397	0.018^{S*}
Gender				
Male	19 (38.0)	27 (54.0)	χ^2=2.576	$0.108^{NS\dagger}$
Female	31 (62.0)	23 (46.0)		
BMI, kg/m^2	26.65±2.80	25.79±3.01	t = 1.631	0.186^{NS*}

Data were expressed as mean ±SD or frequency (%). BMI: Body Mass Index, *Independent sample t-test, †Chi-square test. NS: Statistically Not Significant, S: Statistically significant.

Out of the 50 patients with T2DM, 29 (58%) had positive family history of diabetes. Duration of diabetes was ranged between 2.0-9.0 years with a mean duration of 5.1±1.6 years. According to BMI category, 76% of the diabetic patients were obese, and 16% were overweight. HbA1c level was 7.7±2.1% and glycemic status was uncontrolled in 50% were of the diabetic patients. According to BMI category, 40% of the diabetic patients were obese, and 52% were overweight.

Table II reveals that the TSH levels in the T2DM group were 3.51±0.42 µIU/ml on average, compared to 2.47±0.23 µIU/ml in the control group. This difference was statistically significant (p=0.034). Both groups' mean serum FT3 and FT4 values were comparable (p>0.05).

Table II Comparison of the serum T3, T4 and TSH levels between diabetic and non-diabetic participants

Thyroid hormones	T2DM (n=50)	Non-T2DM (n=50)	t-test	p value and significance*
Serum FT_3 pmol/L	4.10 ± 0.13	3.40 ± 0.19	0.61	0.11^{NS}
Serum FT_4 pmol/L	14.61 ± 0.75	15.16 ± 0.69	-0.58	0.56^{NS}
TSH, µIU/ml	3.51 ± 0.42	2.47 ± 0.23	2.14	0.034^{S}

The data were presented as mean ± standard error of mean. T-test for independent samples, NS: Statistically Not Significant, S: Statistically Significant.

Thyroid dysfunction manifested as subclinical hypothyroidism (18%) and overt hypothyroidism (6%) in 24% of the 50 T2DM patients. The remaining controls in the control group, however, had normal thyroid functions, while 4% of them had thyroid dysfunction and all of them had subclinical hypothyroidism (Table III).

Table III Distribution of the diabetic and non-diabetic participants according to their thyroid dysfunction

Thyroid status	T2DM (n=50)	Non-T2DM (n=50)	Test statistics	p value and significance†
Euthyroid	38 (76.0)	48 (96.0)		
Subclinical hypothyroid	9 (18.0)	2 (4.0)	χ^2=8.617	0.013 S
Overt hypothyroid	3 (6.0)	0 (0)		

†Chi-square test, S: Statistically significant.

Thyroid dysfunction affected approximately 25% of T2DM patients, compared to 4% of the non-T2DM control group. This difference was statistically significant (p=0.004). After controlling for participant age and gender, the results of a logistic regression analysis for thyroid dysfunction in relation to diabetic status are displayed in Table V. Thyroid dysfunction was 7.61 (OR: 7.61, 95% CI: 1.56-37.17, p=0.012) times more likely to occur in T2DM patients than in the non-T2DM group.

Table IV Adjusted effect of diabetic status on thyroid dysfunction by logistic regression analysis

Variables	Thyroid function		OR (95% CI)	p value
	Normal	Abnormal		
Non-T2DM group	48 (96.0)	2 (4.0)	References	
T2DM group	38 (76.0)	12 (24.0)	7.61 (1.56-37.17)	0.012

CI : Confidence Interval, OR : Odds Ratio.

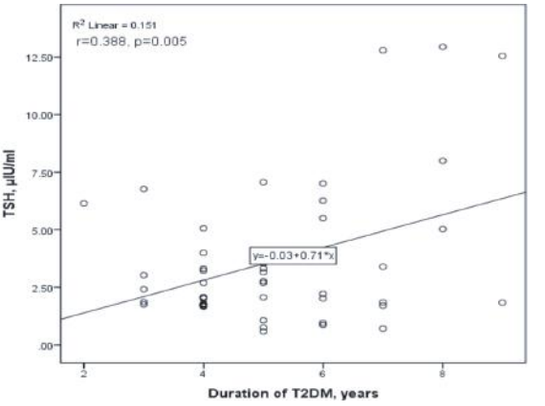

Figure 1 Scatter-dot diagram showing correlation between duration of diabetes and serum TSH level in patients with T2DM

Pearson correlation coefficient test shows that duration of diabetes had moderate positive correlation with serum TSH levels in T2DM patients (r=0.388, p=0.005) (Figure 1).

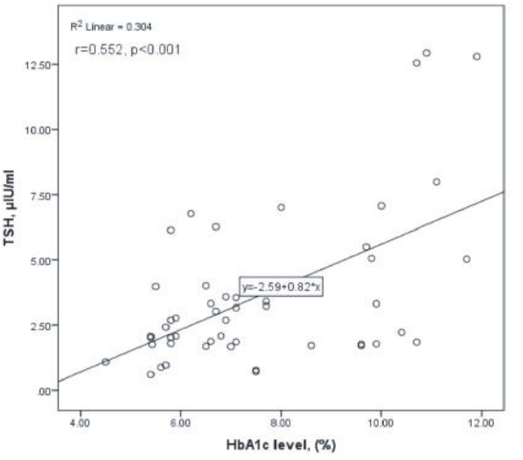

Figure 2 The HbA1C level and serum TSH level in patients with type 2 diabetes are correlated

In T2DM patients, the Pearson correlation coefficient test reveals a moderately positive correlation between serum TSH levels and HbA1C levels (r=0.552, p=<0.001) (Figure 2).

Discussion

According to the study's findings, TSH levels in T2DM patients and non-diabetic participants differed statistically. Thyroid dysfunction, including subclinical and overt hypothyroidism, was also more common in the T2DM group than in the non-diabetic controls. In particular, patients with poor glycemic control and longer duration of diabetes were more likely to have thyroid dysfunction. There was a significant positive correlation between TSH levels and both HbA1c and the length of diabetes.

Serum mean TSH levels in T2DM patients were found to be within the normal range, although they were noticeably higher in T2DM patients than in the non-diabetic control group. However, the study was unable to show any discernible variations in FT4 and FT3 serum levels between T2DM patients and the non-diabetic control group. The mean FT4 levels of T2DM patients and non-diabetic controls did not differ significantly, according to a prior study on the Bangladeshi population. However, TSH and serum FT3 levels were significantly lower in T2DM patients than in the non-diabetic controls.[12] According to Akka et al. diabetic cases had significantly higher levels of TSH, which is influenced by thyroid hormones, than non-diabetic controls.[13] The non-diabetic patients had significantly higher serum FT3 and FT4 levels than the T2DM patients, they also discovered. Serum levels of TSH and FT3 were significantly higher in the group of diabetic patients than in the control group in the study by Elgazar et al. indicating that thyroid dysfunction is more common in diabetic patients.[14] However, FT4 levels were not significantly higher in the diabetic group than in the control group. Some studies, including this one, have small sample sizes, which may account for the differences in results.

Thyroid dysfunction was more common in T2DM patients in this study (24%), compared to 4% in a non-diabetic population sample. According to other research, between 21.9% and 31% of diabetic patients had thyroid dysfunction overall.[10,14] However, other authors reported lower prevalence of 12.3% and 12.7%, respectively.[15,16]

Hypothyroidism, primarily subclinical hypothyroidism, was the only form of thyroid dysfunction found in the 50 T2DM patients. The fact that thyrotropin-realizing hormone synthesis declines in DM may help to explain this.[17] The results of the current study were consistent with previous research demonstrating a high prevalence of hypothyroidism in T2DM, ranging from 12.5% to 32.4%.[18-20] The most common form of thyroid dysfunction, according to other studies, is subclinical hypothyroidism.[21,22] Yet, overt hypothyroidism was more common (87.5%) than subclinical hypothyroidism (12%), according to Muhammed and Albustani.[23]

In the current study, the risk of thyroid dysfunction was 7.61 times higher for T2DM patients than for the non-diabetic group. According to a recent meta-analysis, T2DM was linked to a 1.93-fold increase in the risk of subclinical hypothyroidism (95% CI: 1.66, 2.24), while the current study's results concurred with a systematic review that found an adjusted pooled prevalence of SCH in T2DM patients of 10.2%.[24] Thyroid nodules were found more frequently in T2DM and pre-diabetes than in the normal glucose tolerance controls, according to a recent review by Zhang et al. Patients with type 2 diabetes have a nearly twofold increased risk of developing thyroid nodules when compared to subjects without the disease.[25]

Following an analysis of the relationship between thyroid dysfunction and glycemic control in diabetic patients, the current study found that poor glycemic control was generally linked to thyroid dysfunction. Likewise, Elgazar et al. discovered that the prevalence of thyroid dysfunction dramatically rose at a HbA1c level of ≥8%.[14] However, a higher percentage of patients with normal thyroid functions was linked to better glycemic control. This may indicate that thyroid dysfunction may develop in T2DM patients as a result of inadequate glycemic control.

In T2DM patients, the current study showed a moderately positive correlation between serum TSH levels and the length of diabetes, suggesting that thyroid dysfunction was linked to a longer duration of DM. Thyroid abnormalities in T2DM patients were found to have a longer duration of DM than those with normal thyroid status in other studies.[14,18]

Limitations

Participants were selected from a single center, and it is only limited to those who present to a public tertiary-level hospital for care. The cross-sectional type of the study design was unsuitable for determining the temporal association between thyroid disorder and the incidence of T2DM.

Conclusion

When compared to non-diabetic controls, the current study discovered that patients with type 2 diabetes had a greater prevalence of thyroid function abnormalities, primarily subclinical hypothyroidism. There was a noteworthy positive correlation between TSH and HbA1c. This could imply that thyroid dysfunction in T2DM patients may be influenced by inadequate glycemic control.

Recommendations

In order to aid in the early identification and treatment of thyroid function abnormalities, the current study advised routine screening for thyroid dysfunction in patients with type 2 diabetes, particularly those with higher HbA1c and longer duration of diabetes. To elucidate the detrimental consequences of thyroid disorders and type 2 diabetes when they are linked, large prospective studies are required.

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Contribution of authors

UB-Conception, study design, data collection, data analysis, manuscript writing and final approval.

MHI-Design, critical revision and final approval.

NT-Interpretation of data, critical revision and final approval.

PC-Acquisition of data, drafting and final approval.

MMU-Data analysis, critical revision and final approval.

PKC-Acquisition of data, drafting and final approval.

SA-Interpretation of data, data analysis and final approval.

Disclosure

The authors declared no conflicts of interest.

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