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**ORIGINAL RESEARCH**

# Estimation of thyroid profile in patients with type 2 diabetes mellitus a comparative cross-sectional study

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## ABSTRACT

**Background:** Diabetes mellitus and thyroid abnormalities are the two most prevalent endocrinopathies. Diabetes is one of the fastest-growing non-communicable metabolic syndromes. **Objective:** To determine the relationship between type 2 diabetes mellitus and thyroid disorders and comparison of their prevalence in both sexes. **Methodology:** Every one of the 84 patients who were enrolled in this study had a detailed medical history that included information on their duration, severity, family history, type of treatment, compliance, and control of their glycemic status with co-morbid conditions such as coronary artery disease, hypertension, and cerebrovascular accident. They also underwent a comprehensive general and systemic examination, as well as routine investigations such as complete blood counts, renal function tests, liver function tests, and lipid profiles. **Results:** Most patients were aged 51-60 years (51.2%) and predominantly female (67.9%). The majority of patients had euthyroid status (46.4%), followed by hypothyroid (29.8%), hyperthyroid (15.5%), and subclinical hypothyroidism (8.3%). T3, T4, and TSH levels were significantly different across thyroid disease types, with hypothyroid patients showing the lowest T3 (0.28 ng/dl) and T4 (0.125 µg/dl) and the highest TSH (18.97 µIU/l) levels, while hyperthyroid patients had the highest T3 (0.8 ng/dl) and T4 (1.06 µg/dl) and the lowest TSH (0.051 µIU/l). Additionally, patients with better diabetes control (HbA1c < 7%) had higher T3 (1.64 ng/dl) and T4 (7.97 µg/dl) levels and lower TSH (5.42 µIU/l) compared to those with poor diabetes control (HbA1c > 7%), who had lower T3 (0.98 ng/dl) and T4 (5.84 µg/dl) levels and higher TSH (11.42 µIU/l), with all differences being statistically significant. **Conclusion:** Serum T3, T4, and TSH levels were noticeably aberrant, and there was inadequate glycaemic regulation, according to our observations and results as well as comparisons with other research of a similar nature. Type 2 diabetics are more prone to have altered thyroid hormone levels, particularly in individuals with poor glycaemic control.

**Keywords:** Diabetes mellitus, thyroid profile, Metabolic Syndrome, Insulin Resistance



## INTRODUCTION

The chronic metabolic condition known as type 2 diabetes mellitus (T2DM) is typified by increasing β-cell dysfunction, insulin resistance, and hyperglycemia.(1) It is one of the most common endocrine disorders, affecting millions of people worldwide. The prevalence of T2DM has been increasing rapidly, particularly in developing countries, due to factors such as urbanization, unhealthy diet, physical inactivity, and obesity. Numerous consequences, such as cardiovascular disease, neuropathy, nephropathy, and retinopathy, are linked to this chronic condition and have a substantial negative influence on the quality of life and death rates of those who are affected.Another important part of the endocrine system that is critical for controlling growth, development, and metabolism is the thyroid gland. It generates hormones that are essential for controlling a number of physiological functions, such as energy expenditure, protein synthesis, and enzymatic activity. These hormones include thyroxine (T4) and triiodothyronine (T3).(2)

Thyroid-stimulating hormone (TSH), which is produced by the pituitary gland in response to signals from the hypothalamus, strictly regulates the release of these chemicals.(2)

The interaction between diabetes and thyroid disorders has been a subject of extensiveresearch. It has been established that thyroid hormones influence carbohydrate metabolism and pancreatic function,

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while insulin and insulin resistance can affect thyroid gland activity. Thus, it should come as no surprise that people with type 2 diabetes have an increased risk of thyroid dysfunction, including hyperthyroidism and hypothyroidism.

Thyroid hormone levels in T2DM patients have been a focal point of research due to their potential impact on diabetes management and outcomes. Studies have shown that T2DM patients often exhibit altered thyroid hormone levels compared to non-diabetic individuals. For instance, some studies have reported higher TSH levels in T2DM patients, indicating a higher prevalence of subclinical hypothyroidism. Elevated TSH levels in diabetic patients may result from insulin resistance and hyperinsulinemia, which can influence the hypothalamic-pituitary-thyroid axis.[3]

On the other hand, abnormalities in T3 and T4 levels have also been observed in T2DM patients. Reduced T3 levels, known as low T3 syndrome, have been linked to poor glycemic control and increased cardiovascular risk in diabetic patients. The relationship between thyroid hormone levels and glycemic control is complex and multifaceted, involving interactions between insulin resistance, inflammation, and metabolic stress.[4]

Thyroid dysfunction can significantly affect the management and progression of T2DM.

Hypothyroidism, for example, can exacerbate insulin resistance, making it more challenging to achieve optimal glycemic control. The slowing of metabolic processes in hypothyroidism can lead to weight gain, dyslipidemia, and increased cardiovascular risk, all of which complicate diabetes management.

Hyperthyroidism, although less common in T2DM patients, can also have detrimental effects on diabetes management. The hypermetabolic state induced by excess thyroid hormones can lead to increased insulin resistance, hyperglycemia, and a higher risk of diabetic complications. Moreover, the symptoms of hyperthyroidism, such as increased appetite and weight loss, can mask or mimic the clinical presentation of uncontrolled diabetes, complicating diagnosis and treatment.[3]

This study aims to estimate the thyroid profile in patients with T2DM, exploring the prevalence of thyroid dysfunction and its association with glycemic control. By doing so, we seek to provide a comprehensive understanding of the interplay between these two endocrine disorders, ultimately contributing to the development of targeted clinical guidelines for the integrated management of T2DM and thyroid dysfunction.[4]

## OBJECTIVES OF THE STUDY

To determine relationship between type 2 diabetes mellitus and thyroid disorders and comparasion of their prevalance in both sexes.

## MATERIALS AND METHOD

Every one of the 84 patients who were enrolled in this study had a detailed medical history that included information on their duration, severity, family history, type of treatment, compliance, and control of their glycemic status with co-morbid conditions such as coronary artery disease, hypertension, and cerebrovascular accident. They also underwent a comprehensive general and systemic examination, as well as routine investigations such as complete blood counts, renal function tests, liver function tests, and lipid profiles. At fasting and two hours after meals, the patients underwent plasma glucose estimation using the Thinder's (Glucose oxidase) method, and HPLC was used to estimate their thyroid levels, including T3, T4, and TSH, using an Ultrasensitive sandwich chemiluminescent immunoassay.

A statistical tool for the social sciences (SPSS Version 25) was used to conduct statistical analysis after the collected data was entered into a Microsoft Excel sheet. Whereas the mean and standard deviation were used to display quantitative data, frequency and proportion were used to display categorical data. The Shapiro-Wilk test was used to determine whether the data were normal. An independent t-test was used to compare continuous variables that were regularly distributed between two groups, whereas the Mann Whitney U test was employed for variables that were not. The Chi-square test was used to evaluate the relationship between two groups. A p-value of less than 0.05 was deemed statistically significant. Every statistical test will be run with two tails.

### Inclusion and Exclusion Criteria

**Inclusion Criteria**

Patients with Type2 Diabetes mellitus (age groups 18-80 years)

**Exclusion Criteria**

- Seriously ill patients
- Adults who are previously diagnosed as type 1 diabetes mellitus
- Specific type of Diabetes Mellitus
- Gestational Diabetes Mellitus
- Known case of thyroid disease
- Known case of pancreatitis

## OBSERVATION AND RESULTS

**Table 1: Age distribution among study population**

| Age | Frequency | Percentage |
|---|---|---|
| ≤ 40 Years | 7 | 8.3 |
| 41 -50 years | 14 | 16.7 |
| 51 -60 years | 43 | 51.2 |

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| | | |
|---|---|---|
| > 60 years | 20 | 23.8 |
| Total | 84 | 100 |

Majority of the patients were form the age group of 51-60 years followed by > 60 years, 41-50 years and less than or equal to 40 years as shown in above table.

**Table 2: Gender distribution among study population**

| Gender | Frequency | Percentage |
|---|---|---|
| Male | 27 | 32.1 |
| Female | 57 | 67.9 |
| Total | 84 | 100 |

Majority of the patients were females compared to males, male is to female ratio was 1 : 2.11

**Table 3: Distribution of types of thyroid disease among study population**

| Type of Thyroid Disease | Frequency | Percentage |
|---|---|---|
| Hypothyroid | 25 | 29.8 |
| Hyperthyroidism | 13 | 15.5 |
| Subclinical Hypothyroidism | 7 | 8.3 |
| Euthyroid | 39 | 46.4 |

It was observed that, among all patients, 46.4% of the patients were observed with euthyroid, followed by hypothyroid, hyperthyroid and subclinical hypothyroidism as shown in above table.

**Table 4: Mean distribution of T3 among different types of thyroid disease**

| Type of Thyroid Disease | T3(ng/dl) | | F-value | p-value |
|---|---|---|---|---|
| | Mean | SD | | |
| Hypothyroid | 0.28 | 0.044 | 94.08 | <0.001 |
| Hyperthyroidism | 0.8 | 0.026 | | |
| Subclinical Hypothyroidism | 0.459 | 0.11 | | |
| Euthyroid | 0.47 | 0.118 | | |

Mean distribution of T3 levels among different type of thyroid disease, were found statistically significant as shown in above table.

**Table 5: Mean distribution of T4 among different types of thyroid disease**

| Type of Thyroid Disease | Mean T4(µg/dl) | | F-value | p-value |
|---|---|---|---|---|
| | Mean | SD | | |
| Hypothyroid | 0.125 | 0.074 | 211.885 | <0.001 |
| Hyperthyroidism | 1.06 | 0.029 | | |
| Subclinical Hypothyroidism | 0.84 | 0.25 | | |
| Euthyroid | 0.73 | 0.133 | | |

Mean distribution of T4 levels among different type of thyroid disease, were found statistically significant as shown in above table.

**Table 6: Mean distribution of TSH among different types of thyroid disease**

| Type of Thyroid Disease | TSH(µIU/l) | | F-value | p-value |
|---|---|---|---|---|
| | Mean | SD | | |
| Hypothyroidism | 18.97 | 3.57 | 399.145 | <0.001 |
| Hyperthyroidism | 0.051 | 0.064 | | |
| Subclinical Hypothyroidism | 11.64 | 1.07 | | |
| Euthyroid | 2.8 | 0.72 | | |

Mean distribution of TSH levels among different type of thyroid disease, were found statistically significant as shown in above table.

**Table 7: Mean distribution of T3, T4 and TSH between poor control and good control of diabetes**

| Type of Thyroid Disease | HbA1C | | t-value | p-value |
|---|---|---|---|---|
| | HbA1c < 7.0%(n=33) | HbA1c > 7.0%)(n=51) | | |
| T3(ng/dl) | 1.64±0.49 | 0.98±0.34 | 7.29 | <0.001 |
| T4(µg/dl) | 7.97±3.46 | 5.84±2.17 | 3.47 | 0.0008 |
| TSH(µIU/l) | 5.42±2.04 | 11.42±3.64 | 8.62 | <0.001 |

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Mean T3 among patients with HbA1C less than 7% was higher compared to >7%, similarly T4 with HbA1C less than 7% was higher compared to >7%, and mean TSH among the patients with HbA1C > 7% was higher compared to <7%, and this difference between them statistically highly significant.

**Table 8: Prevalence of different types of thyroid disorder in gender**

| Type of Thyroid Disease | Gender | | Total | Chi-square | p-value |
|---|---|---|---|---|---|
| | Male | Female | | | |
| Hypothyroid | 7(28%) | 18(72%) | 25(100%) | 0.84 | 0.359 |
| Hyperthyroidism | 4(30.8%) | 9(69.2%) | 13(100%) | 0.013 | 0.9 |
| Subclinical Hypothyroidism | 2(28.6%) | 5(71.4%) | 7(100%) | 0.044 | 0.832 |
| Euthyroid | 14(28.6%) | 25(71.4%) | 39(100%) | 0.47 | 0.492 |

It was observed hypothyroid among male was 28%, while among female it was 72%, hyperthyroidism it was more among female, also subclinical hypothyroid more among females, and this difference in the prevalence of different types of hypothyroidism were statistically not significant.

**Table 9: Correlation between HbA1C and thyroid parameters**

| | Thyroid Parameter | R-value | P-value |
|---|---|---|---|
| HbA1C | T3 | 0.184 | 0.132 |
| | T4 | -0.004 | 0.964 |
| | TSH | 0.496** | <0.001 |

**p-value<0.01, highly significant at 1% level of significance.

Correlation between thyroid parameters like T3 and T4 were found not correlated with HbA1C but TSH was significantly moderately positively correlated to HbA1C as shown in above table.

## DISCUSSION

This study indicates that diabetes and thyroid disorders frequently coexist in many patients. Thyroid disorders can significantly impact glucose control, and untreated thyroid issues can complicate diabetes management. Therefore, a systematic approach to thyroid testing in diabetic patients is recommended to prevent cardiovascular complications and other diabetes-related complications such as nephropathy and retinopathy.[5] Early detection of abnormal hormone levels, along with other biochemical variables, in diabetes patients can improve health outcomes and reduce morbidity and mortality.

To ascertain the prevalence and contributing variables of thyroid dysfunction in individuals with type 2 diabetes, numerous research with various methods and goals were carried out. The focus of these studies were prevalence of hypothyroidism which has connection with pathophysiology, pathogenesis, co morbidities, and complications of type-2 diabetes mellitus.[6]Moreover, abnormality of thyroid hormones level attributed to insulin resistance, which decrease conversion of T4 to active T3, also reduced hypothalamus thyrotropin releasing hormone (TRH) in DM patients.[7]In addition to acting as insulin antagonists, thyroid hormones also subtly increase the effects of insulin. The low thyroid hormone levels seen in certain diabetics may be explained by a decrease in TRH synthesis in diabetes mellitus. participants with type 2 diabetes mellitus in our study had clinically significant TSH levels when compared to healthy, non-diabetic participants. The data reveal that hypothyroidism is frequently reported in patients with type 2 diabetes mellitus.

The results of present study were in accordance with the reports of Vinuvij et al,[8] Gurjeetsingh et al,[9] Swamy RM et al,[10] Suzuki et al,[11] Celani et al,[12] Demitrost L et al,[13]

Valerie Witting et al,[14] who in separate study found altered thyroid profi0le in a diabetic patient. One major contributing factor to the poor management frequently observed in some treated diabetes patients may be the failure to identify aberrant thyroid hormone levels in diabetics.

### Demographic Profile

Age-related demographics revealed that the majority of patients were between the ages of 51 and 60, followed by > 60, 41 to 50, and less than or equal to 40. The male to female ratio was 1: 2.11, indicating that females were more likely than males with type 2 diabetes to have thyroid dysfunction. Of all patients in the study, 46.4% had euthyroidism, followed by hypothyroid, hyperthyroid, and subclinical hypothyroidism.

Study conducted by Reeta Taksali et al[15] observed that, females were affected by thyroid dysfunction more than men In addition, diabetic women were more frequently affected than men and hypothyroidism is more than hyperthyroidism.

Study by Dave M et al[16]The results showed that 78 patients (72.2%) were between the ages of 41 and 60, 16 patients (14.8%) were over 61, and 14 patients (13%) were under the age of 40. 64 patients (59.3%) and 44 patients (40.7%) represented the two sex groups in terms of distribution.

Dr. Asha Khubchandani[17] conducted another study in which it was shown that the mean ages of patients with type 2 diabetes mellitus were 36.86 ± 7.21 years and 32.54 ± 6.68 years, respectively, for the control group (P<0.005). Between the two research groups, the sexes were comparable. In patients with type 2

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diabetes mellitus, the male-to-female ratio was 56/44, while in healthy controls it was 51/49.

Another study conducted byAsutiet al.[18] found that participants' mean age was 54.02 ± 8.7 years, and that 55.6% of them were female. Thyroid dysfunction was present in 23.6% of the participants in this study (95% CI 0.184 to 0.293). Of this group, 67.79% (95% CI 0.543 to 0.793) had subclinical hypothyroidism, 5.1% (95% CI 0.010 to 0.141) had overt hypothyroidism, and 27.11% (95% CI 0.163 to 0.402) had overt hyperthyroidism.

Study by Khassawneh A H et al.[19], Kumar et al.[20], and Demitrost L et al.[13] who reported the prevalence rates of 26.7%, 24%, and 31.2%, respectively.

Study conducted by Abdur Rahim Abidia et al[21]noted that, in a study including 100 diabetes people, the proportion of thyroid problems in the subjects was assessed. Of these, 22% had thyroid dysfunction while the remaining 78% were euthyroid. In particular, 3% of people had hyperthyroidism and 19% had hypothyroidism. In participants with diabetes, hypothyroidism was more common (19%) than hyperthyroidism (3%).

In the present study, we have observed that, mean T3 level was 0.50±0.074 ng/dl, while T4 was observed, 0.68±0.12µg/dl and TSH level was8.36±1.35 µUI/dl.

Study conducted by Anveetha et al[22] observed that mean T3 level was 1.08±0.46 ng/dl, while T4 was observed, 6.52±3.14µg/dl and TSH level was 8.52±3.42 µUI/dl.

Dr Asha Khubchandani et al[17]discovered that the control group's serum TSH levels (3.1 ± 2.1 significantly lower than the patients' (6.2 ± 3.1 mIU/L) ($p < 0.001$). However, the serum Total T3 (TT3) of patients with type 2 diabetes mellitus was significantly lower (0.4 ± 0.2 ng/ml) than that of healthy individuals (0.9 ± 0.3 ng/ml) ($p < 0.05$). Additionally, patients with type 2 diabetes mellitus had significantly lower serum Total T4 levels (2.4 ± 1.2 µg/dl) than healthy people (6.2 ± 1.1 µg/dl) ($p < 0.05$). In contrast to the control group, which had significantly lower serum levels of TSH overall, the diabetic group had significantly greater serum levels of T3, T4, and TSH. mIU/L) were Present study observed that, Mean T3 among patients with HbA1C less than 7% was higher compared to >7%, similarly T4 with HbA1C less than 7% was higher compared to >7%, and mean TSH among the patients with HbA1C > 7% was higher compared to <7%, and this difference between them statistically highly significant.

Anveetha et al[22] observed that, the mean serum T3 and T4 levels in patients with good glycemic control were 1.24 ± 0.32 ng/ml and 7.74 ± 3.14 µg/ml, respectively, whereas in patients without good glycemic control, the mean levels were 0.92 ± 0.28 ng/ml and 5.30 ± 1.84 µg/ml. Those with poor glycemic control had significantly lower serum T3 and T4 levels than those with good glycemic control ($p < 0.001$). Patients with strong glycemic control had an average serum TSH level of 7.62 ± 1.92 µIU/ml, while those with poor glycemic control had an average of 9.42 ± 2.96 µIU/ml. Serum TSH levels were considerably greater in patients with inadequate glycemic control than in those with satisfactory glycemic control ($p < 0.001$). There were significant differences in thyroid parameters between patients and controls, with more severe abnormalities seen in those with poor glycemic control. Diabetes affects both endocrine and non-endocrine organs besides the pancreas.

Diabetes patients in this study may have both high and low thyroid hormone levels due to changes in the synthesis and release of thyroid releasing hormone (TRH), which may be influenced by the patients' glycemic state. Insulin, which is thought to modulate the levels of TRH and TSH, influences glycemic status. Endocrine problems, such as altered thyroid hormone levels, can occasionally occur in patients with diabetes.[23-24]

## CONCLUSION

Serum T3, T4, and TSH levels were noticeably aberrant, and there was inadequate glycaemic regulation, according to our observations and results as well as comparisons with other research of a similar nature. Type 2 diabetics are more prone to have altered thyroid hormone levels, particularly in individuals with poor glycaemic control. If not adequately recognised, The poor treatment of diabetes may be significantly influenced by these alterations in thyroid hormones. A greater incidence of hypothyroidism was discovered by our investigation, especially in females. There was shown to be a moderate but substantial association between TSH and HbA1c. In order to improve medical care and lower morbidity, type 2 diabetic patients must have routine thyroid hormone testing.

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