



## Original Research Article

## Study of thyroid profile in relation to glycemic control in type 2 diabetes mellitus patients

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## ABSTRACT

**Background:** Diabetes mellitus is an endocrine metabolic disorder that causes significant morbidity and mortality around the world. Thyroid gland dysfunction is a significant problem in diabetic patients. In diabetics, hypothyroidism is the most common thyroid abnormality. When compared to healthy people, diabetic patients have a higher incidence of thyroid abnormalities. Diabetes mellitus treatment can be complicated due to irregular thyroid activity.

**Materials and Methods:** A total of 120 people were studied, with 60 patients with type 2 diabetes mellitus (Cases group) and 60 healthy people (Control group). Patients with and without strong diabetic control are represented in 60 cases. Both subjects had their fasting venous blood samples taken. In both the cases and control groups, fasting blood sugar, HbA1c, serum T3 (Triiodothyronine), serum T4 (Thyroxine), and serum TSH (Thyroid-stimulating hormone) were measured.

**Results:** The thyroid abnormality was significantly seen in diabetic patients when compared to healthy individuals. The abnormality was more significant in patients with poor glycemic control. When comparing cases to controls, mean serum TSH levels were significantly higher, whereas mean serum T3 and T4 levels were significantly lower.

**Conclusion:** Thyroid hormone levels in type 2 diabetics are abnormal due to a change in the hypothalamic–pituitary–thyroid axis. This in turn produces significant metabolic disturbances. This is more significant in diabetics with poor glycemic control. Routine screening for thyroid function should be done in diabetics, which helps in preventing complications. This contributes to improved treatment by lowering morbidity and improving quality of life.

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## 1. Introduction

Diabetes mellitus (DM), a leading cause of death around the world, is one of the most difficult health issues of the twenty-first century.<sup>1-3</sup> It's a category of metabolic diseases marked by chronic hyperglycemia caused by problems with insulin secretion, insulin action, or both. Diabetes is caused by a variety of pathogenic mechanisms, ranging from autoimmune destruction of pancreatic cells, resulting in insulin deficiency, to defects that result in

insulin resistance.<sup>4,5</sup> The overwhelming majority of diabetic cases can be divided into two groups based on their etiopathogenetic causes. One type of diabetes is Type 1, which is caused by a complete lack of insulin secretion. Type 2 diabetes is a more common form of diabetes mellitus that is caused by a combination of insulin action and secretion problems.<sup>4,5</sup> Diabetes prevalence was projected to be 2.8 percent in 2000 and 4.4 percent in 2030 by the World Health Organization (WHO). The global diabetes population is projected to grow from 171 million in 2000 to 366 million by 2030.<sup>[6,7]</sup> Sedentary behavior, dietary changes, race, hypertension, and obesity are all

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thought to play a role in this epidemic. The two most common endocrinopathies seen in clinical practice are thyroid disease and diabetes mellitus. Diabetes and thyroid disorders have been shown to have reciprocal effects, and a connection between the two has been discovered in the literature.<sup>6,7</sup> In 1979, a study was published that showed a connection between diabetes and thyroid dysfunction.<sup>8</sup> Since then, a variety of studies have reported that between 2.2 and 17 percent of diabetic patients have thyroid dysfunctions.<sup>9,10</sup> However, fewer studies have found a much higher incidence of thyroid dysfunction in diabetics, at 31 percent and 46.5 percent, respectively.<sup>11,12</sup> Thyroid disorders are more common in diabetic patients than in the general population.<sup>13</sup>

Upon stimulation by thyroid-stimulating hormone (TSH), the thyroid gland responds by producing and releasing the 2 thyroid hormones: Triiodothyronine (T3) and Thyroxine (T4).<sup>14</sup> Hyperthyroidism and hypothyroidism are the two most common thyroid gland pathological disorders.<sup>15,16</sup> Hypothyroidism is the most common thyroid condition in adults, and it occurs when the thyroid gland does not produce enough thyroid hormones. Hyperthyroidism is a disorder in which the thyroid gland is overactive and releases too many thyroid hormones.<sup>4</sup>

Since insulin and thyroid hormones are so intertwined in cellular metabolism, having too much or too little of one causes the other to malfunction. Insulin's physiological and biochemical interactions, as well as the effects of insulin and iodothyronines on carbohydrate, protein, and lipid metabolism, have been studied. According to these documents, iodothyronines are insulin antagonists, with high levels being diabetogenic and the absence of the hormone inhibiting the development of diabetes.<sup>17</sup>

Thyroid dysfunction can make diabetes more difficult to manage. Hyperthyroidism raises the rate of gastrointestinal glucose absorption, as well as insulin resistance and insulin degradation, and is linked to worsening glycemic control in diabetics, whereas hypothyroidism increases hypoglycemia vulnerability, complicating diabetes management.<sup>18</sup> Thyroid hormone disorders are often linked to diabetes, and thyroid dysfunction that goes undiagnosed may harm diabetes and its complications.<sup>7</sup> This study aimed to assess the thyroid profile in type 2 diabetic patients.

## 2. Materials and Methods

The total numbers of subjects studied were 120, comprising 60 patients of type 2 diabetic mellitus (Cases group) and 60 normal healthy individuals (Control group). 60 cases include patients with and without good glycemic control. Both cases and controls gave their informed consent.

The cases were chosen using a straightforward random sampling procedure. Patients with coronary artery disease, cerebrovascular accident, hypertension were included in exclusion criteria. The duration of diabetes, treatment

(hypoglycemic agent or insulin or diet control alone) was noted. Cases and controls have given fasting blood samples. Serum T3, T4, and TSH were estimated by using CLIA (Chemiluminescence Immunoassay) method and Fasting blood glucose by Glucose Oxidase-Peroxidase method HbA1c was estimated by Ion-Exchange Resin method.

### 2.1. Inclusion criteria

1. Cases: 60 type-2 diabetics of age 45 - 60 yrs of both genders who were on treatment, with no known complications and no history of previous thyroid disease were included. 60 cases include patients with and without good diabetic control
2. Controls: 60 age and sex-matched normal healthy individuals without any history of diabetes and known systemic disorders were included.

### 2.2. Exclusion criteria

Individuals with a previous history of thyroid disease and on drugs that affect thyroid function, pregnancy, patients with diabetic complications (coronary artery disease, cerebrovascular accident, hypertension).

Criteria used in the study for the diagnosis of type 2 DM (According to American Diabetic Association) are 1) FBS (Fasting Blood Sugar)  $\geq$  126 mg/dl (7.0 mmol/L) or 2) Symptoms of diabetes plus RBS (Random Blood Sugar)  $\geq$  200 mg/dl (11.1 mmol/L).

### 2.3. Statistical analysis

The results obtained and expressed in mean  $\pm$  SD. Student t-test was used to compare the two classes, and SPSS statistical package version 15.0 was used to evaluate each parameter statistically. A p-value of 0.05 was considered statistically important.

## 3. Results

The participants in this study ranged in age from 45 to 60 years old. The mean age of diabetics was  $50.96 \pm 4.86$  years and the mean age of controls was  $51.24 \pm 5.14$  years. This case-control research included 60 type 2 diabetic patients of both genders who were on medication and had no reported symptoms or prior thyroid disease.

When compared to controls, serum T3 and T4 levels were significantly lower, whereas serum TSH levels were significantly higher in cases. Within the cases, the abnormality in thyroid hormones was more significant in cases without good glycemic control (HbA1c  $>$  7.0%).

## 4. Discussion

Diabetes, an endocrine metabolic disorder with a wide range of symptoms, is a leading cause of morbidity and mortality around the world. It has a global distribution and is

**Table 1:** Sex and age wise distribution of cases and controls

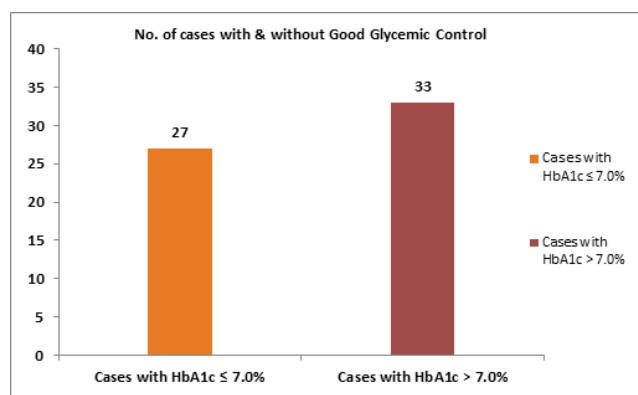
	Males	Females	Mean ages
Cases	36	24	50.96 ± 4.86
Controls	32	28	51.24 ± 5.14

**Table 2:** Test parameters in cases and controls

Parameter	Cases(Mean ± SD)	Controls(Mean ± SD)	'P' value	Inference
FBS (mg/dl)	198.12 ± 54.46	96.28 ± 12.24	< 0.001	Significant
HbA1c (%)	8.52 ± 2.36	5.12 ± 0.16	< 0.001	Significant
T3 (ng/ml)	1.08 ± 0.46	1.49 ± 0.38	< 0.05	Significant
T4 (µg/ml)	6.52 ± 3.14	8.24 ± 2.12	< 0.05	Significant
TSH (µIU/ml)	8.52 ± 3.42	2.36 ± 1.68	< 0.05	Significant

**Table 3:** Thyroid parameters in cases with good glycemc control and cases without good glycemc control

Parameter	Cases With Good Diabetic Control (HbA1c ≤ 7.0%)	Cases Without Good Diabetic Control (HbA1c > 7.0%)	'P' value	Inference
T3 (ng/ml)	1.24 ± 0.32	0.92 ± 0.28	< 0.01	Significant
T4 (µg/ml)	7.74 ± 3.14	5.30 ± 1.84	< 0.01	Significant
TSH (µIU/ml)	7.62 ± 1.92	9.42 ± 2.96	< 0.01	Significant

**Fig. 1:** Showing Mean HbA1c levels in Cases

becoming more common every day, posing a serious threat to public health around the world.<sup>19</sup> India will continue to have the highest number of diabetic subjects as a result of rapid urbanization and economic growth.<sup>20</sup> Diabetes is commonly associated with altered thyroid function. After diabetes, thyroid disorders are the most prevalent endocrine disorders in the general population. As a result, it is normal for a person to suffer from both thyroid disease and diabetes.<sup>1</sup> The study aims to look at the levels of serum T3, T4, and TSH, as well as fasting blood sugar in type 2 diabetics. The present study includes 120 subjects of which 60 were known type 2 diabetic patients (cases) and 60 were normal healthy controls. When compared to controls, diabetics had significantly lower serum T3, T4 levels, while diabetics had significantly higher serum TSH levels. This is by the studies of Vikram BV et al.,<sup>21</sup> Gurjeet S et al.,<sup>1</sup> and Shekhar CY et al.<sup>15</sup>

The mean fasting blood sugar level in controls was 96.28 ± 12.24 mg/dl and the mean fasting blood sugar level in cases was 198.12 ± 54.46 mg/dl. The mean HbA1c level in controls was 5.12 ± 0.16% and the means HbA1c levels in cases was 8.52 ± 2.36%. When comparing cases to controls, fasting blood sugar and HbA1c levels were significantly higher in cases (p-value 0.001). This is consistent with the findings of Priti S et al.,<sup>22</sup> Reeta T et al.<sup>23</sup> and Samatha P et al.<sup>24</sup>

The mean serum T3 & T4 levels in controls were 1.49 ± 0.38 ng/ml & 8.24 ± 2.12 µg/ml and mean serum T3 & T4 levels in cases were 1.08 ng/ml ± 0.46 & 6.52 ± 3.14 µg/ml. There was a significant decrease in serum T3 & T4 levels in cases when compared to controls (p-value < 0.05). The mean serum TSH levels in controls were 2.36 ± 1.68 µIU/ml and mean serum TSH levels in cases was 8.52 ± 3.42 µIU/ml. When compared to controls, there was a significant increase in serum TSH levels in cases (p-value < 0.05). Out of 60 diabetic subjects investigated in the present study, 32% of diabetic patients had shown thyroid dysfunction with hypothyroidism. These findings support studies by Vibha U et al.<sup>6</sup> and Pasupathi P et al.<sup>25</sup> that indicate a high incidence of abnormal thyroid hormone levels in diabetics.

The mean serum T3 & T4 levels in cases with good glycemc control were 1.24 ± 0.32 ng/ml & 7.74 ± 3.14 µg/ml and mean serum T3 & T4 levels in cases without good glycemc control were 0.92 ± 0.28 & 5.30 ± 1.84 µg/ml. When compared to cases with good glycemc control, serum T3 and T4 levels were significantly lower in cases without good glycemc control (p-value < 0.001). The mean serum TSH levels in cases with good glycemc control was 7.62 ± 1.92 µIU/ml and mean serum TSH levels

in cases without good glycemic control was  $9.42 \pm 2.96$   $\mu$ IU/ml. When compared to cases with good glycemic control, there was a large rise in serum TSH levels in cases without good glycemic control (p-value < 0.001). When comparing cases to controls, thyroid parameters show a noticeable difference. In cases where glycemic regulation was weak, the abnormality was more pronounced. Diabetes is influenced by endocrine and non-endocrine organs other than the pancreas. Some endocrine abnormalities, such as altered thyroid hormone levels, are occasionally discovered in diabetic patients. The presence of both high and low thyroid hormone levels in diabetics in this study may be due to a change in thyroid releasing hormone (TRH) synthesis and release, which could be influenced by the diabetics' glycemic status. Insulin, which is believed to modulate the levels of TRH and TSH, influences glycemic status.<sup>9,26</sup>

In diabetes, there are alterations in the hypothalamic–pituitary–thyroid axis. The hypothalamic and plasma TRH, pituitary and plasma TSH, and TSH secretion rate are among the most significant changes. Despite normal peripheral TSH metabolism, the response of TSH to TRH is also decreased. Thyroid gland output of T3 and T4, as well as iodide uptake, are reduced. Both the thyroid and pituitary glands undergo significant structural changes, which are followed by significant changes in their secretory activities. Furthermore, the deiodination of T4 to T3 is reduced.<sup>25</sup> Thyroid hormone-binding inhibitor (THBI), an inhibitor of the extrathyroidal conversion enzyme (5'-deiodinase) of T4 to T3, and hypothalamic–pituitary–thyroid axis dysfunction were attributed by Suzuki et al to abnormal thyroid hormone levels observed in diabetes. These conditions can arise in diabetics, and they will be exacerbated in diabetics who are poorly regulated. In these diabetics, stress, which is linked to diabetes, can trigger changes in the hypothalamus-anterior pituitary axis.<sup>27</sup>

## 5. Conclusion

When type 2 diabetics were compared to controls, serum T3 and T4 levels were lower, while serum TSH levels were higher. In cases where glycemic regulation was poor, abnormalities in serum T3, T4, and TSH levels were more noticeable. Thyroid hormone levels that are altered are more common in type 2 diabetics. Thyroid hormone abnormalities were more prevalent in diabetics with impaired glycemic regulation. Thyroid hormone levels that are altered in diabetics can be a primary cause of poor control in some treated diabetics if they are not understood. Thyroid hormones must be tested in diabetics to diagnose and treat thyroid disease early. Diabetics should have their thyroid function checked regularly to help avoid complications. This contributes to improved treatment by lowering morbidity and improving quality of life.

## 6. Source of Funding

None.

## 7. Conflict of Interest

None.

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