

# Study of Thyroid Disorders in Type 2 Diabetic and Non-Diabetic Patients Attending a Tertiary Care Hospital

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## ABSTRACT

### BACKGROUND

Patients with DM are at increased risk of thyroid disease, especially those with poor glycaemic control. The following mechanisms are thought to be responsible. In patients with DM, the nocturnal TSH peak is blunted or abolished; the TSH response to TRH, from the hypothalamus, is impaired thus leading to hypothyroidism. We wanted to study the thyroid disorders in type 2 diabetic and non-diabetic patients attending a tertiary care hospital.

### METHODS

This is an analytical observational study conducted among 100 type 2 diabetic and 100 non-diabetic patients attending medicine OPD in the Department of General Medicine of Narayan Medical College & Hospital, Jamuhar, Distt. Rohtas over a 6-month period from Oct 2019 to April 2020.

### RESULTS

The mean age of group A and group B was found to be  $51.79 \pm 10.374$  and  $49.86 \pm 9.538$  respectively. In group A (diabetes mellitus patients), 71 (71 %) patients were euthyroid whereas in group B (healthy individuals) 84 (84 %) patients were euthyroid. In Group A (diabetes mellitus group) either subclinical or overt hypothyroidism was seen in 26 (26 %) patients and hyperthyroidism was seen in 3 (3 %) patients. In Group B (healthy individuals) either subclinical or overt hypothyroidism was seen in 14 (14 %) patients and hyperthyroidism was seen in 2 (2 %) patients.

### CONCLUSIONS

The comparison of the patients of control and cases groups on the basis of whether they had a normal or abnormal thyroid function test showed that patients with diabetes mellitus type 2 (Group A) were more likely to be having abnormal thyroid function test as compared to healthy individuals (Group B) and this difference was found to be statistically significant ( $p = 0.027$ ).

### KEYWORDS

Type 2 DM, Hypothyroid, Hyperglycaemia, Hyperthyroid

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**BACKGROUND**

Diabetes mellitus is a very common disease with a global prevalence rate of 8.5 % in adult subjects, most of whom are type 2 DM (T2D). T2D is due to insulin resistance associated with insulin deficiency, which may result in carbohydrate derangement and hyperglycaemia.<sup>1</sup>

With improving socioeconomic status and change towards more sedentary life style the incidence of diabetes mellitus is increasing globally. Growing incidence of diabetes mellitus pose a great challenge to almost all countries of the world and according to some studies by 3rd decade of this century more than 600 million will be affected by diabetes mellitus. Not only its incidence is increasing in developing world but also it is affecting more younger individuals. Some studies have shown that almost 50 % of the patients of diabetes mellitus are below 60 years of age.<sup>2</sup>

Thyroid diseases are second most common endocrine disorders affecting general population. Therefore it is common for a person to be affected by both diabetes and thyroid disease. Previous studies have showed higher prevalence of thyroid dysfunction in diabetes patients.<sup>3</sup>

Patients with DM are at increased risk of thyroid disease, especially those with poor glycaemic control. The following mechanisms are thought to be responsible. In patients with DM, the nocturnal TSH peak is blunted or abolished; and the TSH response to TRH, from the hypothalamus, is impaired thus leading to hypothyroidism. Low T3 levels have been observed in uncontrolled DM. This has been ascribed to the impairment in peripheral conversion of T4 to T3 which normalizes with improvement in glycaemic control. This is as a result of the hyperglycaemia-induced reversible reduction of the activities and hepatic concentration of thyroxine 5'deiodinase.<sup>4</sup>

Thyroid hormones and insulin are antagonists, and both are involved in cellular metabolism of carbohydrates, proteins, and lipids. The functional impairment occurs in thyroid hormone as well as insulin if their levels changed. DM appears to influence thyroid function in two sites; firstly, at the level of hypothalamic control of TSH release and secondly at the conversion of T4 to T3 in the peripheral tissue.<sup>5</sup>

The co-existence dysfunction of thyroid in type 2 diabetes mellitus will worsen the macro vascular and microvascular complications, morbidity, mortality, and quality of life. "Functional changes in the thyroid gland may be related to metabolic syndrome with its associated factors which include obesity, Insulin Resistance (IR), raised blood pressure, lipid and glucose metabolism abnormalities, and cardiovascular dysfunction."<sup>6</sup>

With this background in mind we conducted this comparative study of thyroid function abnormalities in patients with Type II diabetes mellitus and non-diabetic patients in tertiary care hospital.

**METHODS**

We conducted an analytical observational study among 100 type 2 diabetic and 100 non-diabetic patients attending Medicine OPD in the Department of General Medicine of Narayan Medical College & Hospital, Jamuhar, Distt. – Rohtas; over a 6-months period from Oct 2019 to April 2020. Diabetes was defined as per American Diabetes Association criteria (fasting plasma sugar > 126 mg / dL and post-prandial > 200 mg / dL or glycated haemoglobin [HbA1c] > 6.5 %)

In all the patients' demographic details such as age, sex, height, weight, residential address and BMI (Body Mass Index) were recorded. A detailed history was taken with respect to presence of diabetes in other family members, duration of diabetes in patient and treatment record was also reviewed. Presence of co-morbidities such as presence of hypertension, chronic obstructive pulmonary disease was also enquired into. Treatment history was reviewed and whether patients were on oral hypoglycaemic agents or insulin was recorded.

A detailed general and systemic examination was done in all the cases. Fasting and postprandial blood sugar level, glycosylated haemoglobin, complete blood count and lipid profile was done in all the cases. To assess the severity of end organ damage renal function tests (blood urea and serum creatinine) was done in all the cases. Serum free T3, T4 and TSH was done in all the cases. On the basis of thyroid function tests the patients were classified into subclinical hypothyroidism, overt hypothyroidism, hyperthyroidism and subclinical hyperthyroidism.

Subclinical hypothyroidism: TSH - 4.5 to 10 mIU / L and normal free T4.

Overt hypothyroidism: TSH more than 10 mIU / L with low free T4 levels.

Overt Hyperthyroidism: TSH less than 0.45 mIU / L and raised free T4.

Subclinical hyperthyroidism: TSH less than 0.45 mIU / L and normal free T4.

**Inclusion Criteria**

1. Patients with diabetes (fasting blood sugar level more than 140 mg / dL and postprandial blood sugar level of more than 200 mg / dL on minimum 2 separate occasions).

**Exclusion Criteria**

1. Patients with uncontrolled hypertension, severe chronic obstructive airway disease.
2. Patients known to be on drugs known to affect thyroid functions such as lithium, amiodarone, interferon, aminoglutethimide etc.
3. Known cases of thyroid disorders.
4. Patients with autoimmune diseases.

The thyroid function abnormalities were compared in both the groups (diabetic and non-diabetic). For statistical purposes p value less than 0.05 was taken as "significant". Microsoft Excel and Epi info 7.1 software was used for statistical analysis.

## RESULTS

Out of 100 cases of diabetes mellitus (cases), there were 61 males and 39 females whereas amongst 100 individuals in control group (healthy individuals) there were 70 males and 30 females. The analysis of gender distribution amongst the cases and control group showed that gender distribution was comparable in both the groups with no statistically significant difference.

Age Group	Diabetic Group		Non Diabetic Group	
	No. of Patients	%	No. of Patients	%
30 - 40 years	18	18	16	16
41 - 50 years	30	30	47	47
51 - 60 years	31	31	22	22
61 - 70 years	20	20	10	10
≥ 71 years	01	01	05	05
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
Mean Age: 51.79 ± 10.374, Range- 33-78 yrs.		Mean Age: 49.86 ± 9.538, Range- 35-80 yrs.		
<b>Table 1. Distribution of Study Subjects as per Age in Both Groups</b>				
t. value = 1.37, p value = 0.17, no significant difference				

	Diabetic Group		Non-Diabetic Group	Significance
Fasting Blood Sugar	163.03 ± 88.72 mg / dL, ( 83-569 mg / dL)	91.80 ± 8.78 mg / dL ( 70 - 105 mg / dL)		< 0.001
Post Prandial Blood Sugar	263.88 ± 122.12 mg / dL, (102 - 705 mg / dL)	110.83 ± 12.24 mg / dL ( 94 - 141 mg / dL)		< 0.001
HbA1c	7.30 ± 1.80 ( 5 - 12)	4.97 ± 0.388 (4-6)		< 0.001
<b>Table 2. Mean Blood Sugar Level of Study Subjects In Both Groups</b>				

The age groups of the patients were analysed. Age distribution of group A (cases of diabetes mellitus) showed that the most common age group was found to be between 51 - 60 years (31 %) followed by 41 - 50 years (30 %) and 61 - 70 years (20 %). There were 18 (18 %) patients below 40 years of age and only 1 % above 70 yrs. In group B (control group) the most common age group was found to be 41 - 50 years (47 %) followed by 51 - 60 years (22 %) and 30 - 40 years (16 %). The mean age of group A and group B was found to be 51.79 ± 10.374 and 49.86 ± 9.538 respectively. The age groups were found to be comparable and there was no statistically significant difference in mean age of both the groups (p = 0.17).

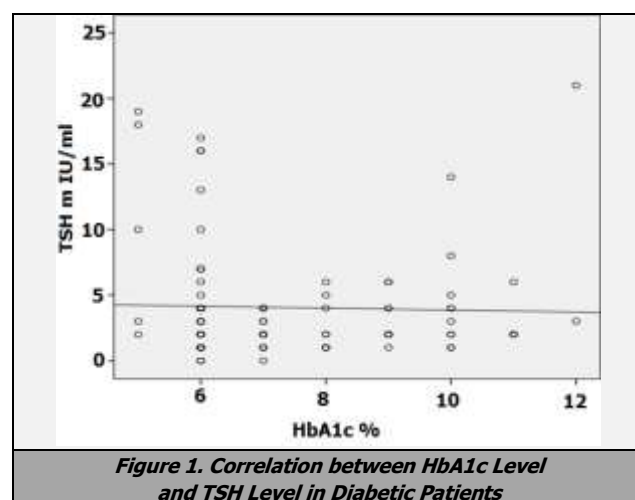
Mean blood sugar glucose levels of patients in control as well as cases groups were analysed. The mean fasting, postprandial blood glucose level and HBA1C level in control group (non-diabetic individuals) was found to be 91.80 ± 8.78 mg / dL, 110.83 ± 12.24 mg / dL and 4.97 ± 0.388. In cases group (individuals with diabetes mellitus) the mean fasting, and postprandial blood glucose levels were found to be 163.03 ± 88.72 mg / dL and 263.88 ± 122.12 mg / dL respectively. The HBA1C level in diabetic group was 7.30 ± 1.80. The difference in fasting, postprandial mean blood sugar levels and HbA1c level in studied groups was found to be statistically highly significant. (P < 0.001).

Thyroid Status	Diabetic Group		Non-Diabetic Group	
	No. of Patients	%	No. of Patients	%
Euthyroid	71	71	84	84
Hypothyroid (subclinical or overt)	26	26	14	14
Hyperthyroid (subclinical or overt)	3	3	2	2
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Table 3. Distribution of Study Subjects in Both Groups as per Their Thyroid Status</b>				
p value = 0.027, Significant association				

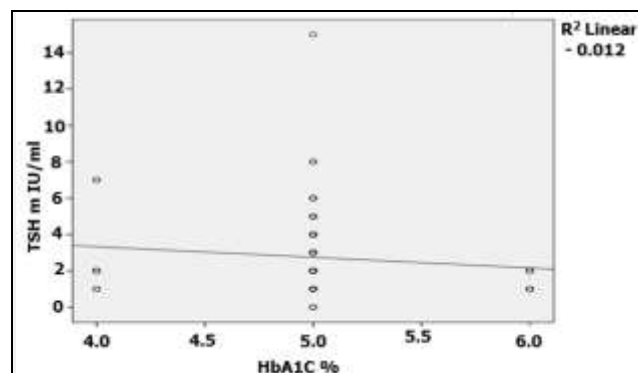
The analysis of thyroid function tests showed that in group A (diabetes mellitus patients) 71 (71 %) patients were euthyroid whereas in group B (healthy individuals) 84 (84 %) patients were euthyroid. In Group A either subclinical or overt hypothyroidism was seen in 26 (26 %) patients and hyperthyroidism was seen in 3 (3 %) patients. In Group B either subclinical or overt hypothyroidism was seen in 14 (14 %) patients and hyperthyroidism was seen in 2 (2 %) patients.

The comparison of the patients of control and cases groups on the basis of whether they had a normal or abnormal thyroid function test showed that patients with diabetes mellitus type 2 (Group A) were more likely to be having abnormal thyroid function test as compared to healthy individuals (Group B) and this difference was found to be statistically significant (p = 0.027).

Thyroid Profile	Diabetic Group		Non-Diabetic Group		P Value
	Mean	SD	Mean	SD	
TSH level	4.06	4.301	2.76	2.08	0.007
T4 level	1.43	0.685	1.19	0.394	0.002
T3 level	2.46	1.176	2.18	0.609	0.035
<b>Table 4. T3, T4, TSH LEVEL in Both the Groups</b>					



The thyroid function test of patients was analysed for abnormalities. The mean free T4 levels in group A was 1.43 ± 0.685 whereas in group B it was found to be 1.19 ± 0.394. The difference was found to be statistically significant (p = 0.002). Mean T3 level in diabetic group 2.46 ± 1.176, whereas 2.40 ± 0.532. (p = 0.035, statistically significant) Mean TSH level in Group A was found to be 4.06 ± 4.301 whereas in group B it was found to be 2.76 ± 2.08. The difference was found to be statistically highly significant (p = 0.007).



**Figure 2. Correlation between HbA1c Level and TSH Level in Non-Diabetic Patients**

When we do regression analysis for finding correlation between TSH level and HBA1C level we do not find any correlation in both diabetic ( $R^2 = 0.001$ ) and nondiabetic patients ( $R^2 = 0.012$ ).

## DISCUSSION

We had conducted this comparative study to compare thyroid functions in diabetes mellitus patients and nondiabetic individuals. We included total 200 individuals in this study out of which 100 patients were having diabetes mellitus type 2 (Group A) and remaining 100 were nondiabetic individuals (Group B). The gender and age distribution, fasting and post prandial glucose levels and thyroid functions of both the groups were compared.

In the present study there were 61 males and 39 females whereas amongst 100 individuals in control group (healthy individuals) there were 70 males and 30 females with no significant difference between two groups. Other studies done on similar topic such as study by Radhakrishna G et al had 38 males and 22 females in 60 cases whereas amongst 60 individuals in control group (healthy individuals) there were 35 males and 25 females with no significant difference, which is almost like our study.

In our study the mean age of study subject in group A and group B was found to be  $51.79 \pm 10.374$  and  $49.86 \pm 9.538$  respectively. The age groups were found to be comparable and there was no statistically significant difference in mean age of both the groups ( $p = 0.17$ ). Other studies such as by Radhakrishna G et al<sup>2</sup>, Talsaniya K et al<sup>7</sup> also had almost similar findings. Different mean age of patients with diabetes was also reported by the authors such as Stryjewski PJ et al<sup>8</sup> (mean age 66.9 years, SD 13.2) and Hayashino Y et al<sup>9</sup> (61.4 years).

In our study thyroid function abnormalities (either hypothyroidism or hyperthyroidism) were found in 29 (29 %) patients in group A whereas in group B thyroid function abnormalities (either hypothyroidism or hyperthyroidism) were found in 16 (16 %) patients. Patients with diabetes mellitus type 2 (Group A) were more likely to be having abnormal thyroid function test as compared to healthy individuals (Group B) and this difference was found to be statistically significant ( $p = 0.027$ ). Other studies such as

Talsaniya K et al<sup>7</sup> shows occurrence of thyroid dysfunction was found in 16% of patients with Type 2 DM.

In our study in both group total hypothyroidism is more common (26 % in cases, 14 % in healthy) than hyperthyroidism (3 % in cases, 2 % in healthy). This is also supported by various studies like Moghetti et al<sup>10</sup> which showed 89 % hypothyroidism and 11 % hyperthyroidism. Gronich et al<sup>11</sup> reported that hypothyroidism was frequently seen and was a risk factor in new-onset T2D. Radhakrishna A et al<sup>2</sup> showed patients with diabetes mellitus type 2 (Group A) were more likely to be having abnormal thyroid function test as compared to healthy individuals (Group B) and this difference was found to be statistically significant ( $p = 0.0138$ ). The reasons for both high and low level of thyroid hormones in diabetes are the modified TRH synthesis and release is also due to various medications used for DM. Many studies concluded that the treatment of DM by sulfonylurea leads to an increase in occurrence of goitre and hypothyroidism.

In our study Mean TSH level in Group A was found to be  $4.06 \pm 4.301$  whereas in group B it was found to be  $2.76 \pm 2.08$ . The difference was found to be statistically highly significant ( $p = 0.007$ ). Other study such as Kaur A<sup>12</sup> conducted a study in Patiala to find association between diabetes and hypothyroidism and concluded that in cases group the levels of serum TSH, TG and FBS were significantly higher as compared to the control group with the  $p$  value  $< 0.001$ . Telwani AA et al in their study found the levels of serum T3 and T4 were significantly low while serum TSH levels were significantly high in diabetic group compared to control group. Radhakrishna A et al in their study concluded that Mean TSH level in Group A (diabetic individuals) was found to be  $5.26 \pm 1.42$  whereas in group B it was found to be  $3.02 \pm 0.78$ . The difference was found to be statistically highly significant ( $p < 0.0001$ ). These findings are almost similar to our study findings.

## CONCLUSIONS

Increased prevalence of thyroid abnormality was seen in T2DM patients which is consistent with many previous studies, hence it may be advisable to check thyroid status in all T2DM patients for the better management of T2DM.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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