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Prevalence and Patterns of Thyroid Dysfunction Among Type II Diabetes Mellitus Patients: A Case-Control Study in Tamil Nadu, South India.

Kayalvizhi V[1]*, Dhanapriya S[2], Manoji Selva Jaya Singh[3], Jayakala T[4], and Hemapriya AS[5].

[1]Senior Assistant Professor, Dept of Biochemistry, Thanjavur Medical College, Thanjavur, Tamil Nadu, India.
[2]Assistant Professor, Department of Biochemistry, Government Medical College, Kallakurichi, Tamil Nadu, India.
[3]Assistant professor, Department of Biochemistry, Thanjavur Medical College, Thanjavur, Tamil Nadu, India.
[4]Assistant Professor, Department of Biochemistry, Kanyakumari Government Medical College, Asaripallam, Kanyakumari, Tamil Nadu, India.
[5]Independent Researcher, Chennai, Tamil Nadu, India.

ABSTRACT

Endocrine disorders like Type 2 diabetes mellitus (T2DM) and thyroid dysfunction (TD) are common in clinical practice, with a bidirectional relationship between the two. Diabetes increases the likelihood of developing thyroid disorders, especially due to poor blood glucose control. This study aims to enhance understanding of the prevalence of thyroid dysfunction in diabetic patients and investigate the effects of diabetes on thyroid hormone levels. This case-control study was conducted at Thanjavur Medical College and Hospital, Tamilnadu, India from April 2022 to March 2023. The study included 170 Type 2 Diabetes Mellitus (T2DM) patients (cases) and 50 non-diabetic individuals (controls) aged 30-80 years, selected through purposive sampling. The Type 2 DM patients exhibited significantly higher fasting blood glucose, post-prandial blood glucose, and HbA1c levels compared to the control group ($p < 0.001$), reflecting poorer glycaemic control. Thyroid function tests (Free T3, Free T4, and TSH) did not show significant differences between the two groups, except for TSH, which was significantly higher in the T2DM group ($p < 0.05$). Subclinical hypothyroidism was more prevalent in females, and although hypothyroidism, hyperthyroidism, and subclinical hypothyroidism were more common in the T2DM group, the differences were not statistically significant. The study identified a significant association between T2DM and altered thyroid function, particularly elevated TSH levels, with subclinical hypothyroidism being more prevalent among females. These findings highlight the importance of routine thyroid screening in T2DM patients for early detection and improved management.
Keywords: Type 2 Diabetes Mellitus, Thyroid Dysfunction, Tamil Nadu, India.

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***Corresponding author**

INTRODUCTION

Diabetes mellitus (DM) and thyroid dysfunction (TD) are common endocrine disorders that often coexist, presenting a significant and increasing public health challenge, especially in developing nations [1, 2]. Hypothyroidism affects 4-5% of the population in developed countries, whereas in India, it is estimated that approximately one in ten adults is affected [3, 4]. The link between diabetes and thyroid dysfunction has been well-established, with the first studies on the topic published in 1979.Studies have indicated a higher prevalence of thyroid disorders in individuals with type 2 diabetes mellitus (T2DM), ranging from 12% to 23%. The World Health Organization (WHO) estimated that the prevalence of diabetes was 2.8% in 2000 and is projected to increase to 4.4% by 2030. The total number of people living with diabetes is expected to rise from 171 million in 2000 to 366 million by 2030(5). Diabetes mellitus (DM) seems to affect thyroid function in two primary ways: first, at the level of hypothalamic control of TSH release, and second, at the peripheral tissues by influencing the conversion of T4 to T3. Hyperglycemia leads to a reduction in hepatic concentration of T4-5 deiodinase, which results in low serum T3 levels, elevated reverse T3, and variable T4 levels (low, normal, or high). Since thyroid hormones play a key role in regulating metabolism, diabetes can alter metabolic processes. It was also observed that thyroid dysfunction becomes more prevalent with age, with women showing a higher frequency of thyroid disease compared to men. Additionally, individuals with diabetes have a higher prevalence of thyroid disorders than those without diabetes [5]. Additionally, poorly controlled blood glucose levels can influence the levels of plasma triiodothyronine (T3) and thyroxine (T4) [6]. Therefore, this study aims to enhance understanding of the prevalence of thyroid dysfunction, the impact of diabetes on thyroid hormone levels, and provide insights into the need for early screening and management of thyroid disorders in this high-risk group.

Objectives

- To assess the prevalence and severity of thyroid dysfunction among patients with type 2 diabetes mellitus.
- To evaluate thyroid hormone levels (Free T3, Free T4, and TSH) among Type 2 Diabetes mellitus patients.
- To compare thyroid hormone levels and thyroid dysfunction between Type 2 Diabetes mellitus patients and controls.

METHODS

This case-control study was conducted at Thanjavur Medical College and Hospital, Tamilnadu, India from April 2022 to March 2023. The study population comprised 170 Type 2 Diabetes Mellitus (T2DM) patients (cases) and 50 non-diabetic individuals (controls) aged between 30 and 80 years using purposive sampling. Participants were recruited from the outpatient departments of Medicine, Surgery, and Endocrinology. Ethical approval was obtained from the Institutional Ethics Committee, and informed written consent was secured from all participants after explaining the study objectives. Cases were selected based on a confirmed diagnosis of T2DM through history and biochemical investigations. Controls were non-diabetic individuals within the same age range. Patients with Type 1 Diabetes Mellitus, specific types of diabetes, gestational diabetes mellitus, thyroid disorders, cancer, or serious illness were excluded. A thorough clinical history was taken, including details about the onset and duration of diabetes mellitus, any history of long-term illnesses, previous thyroid dysfunction, prior drug therapies, and whether the patient was using insulin or oral hypoglycemic drugs. A comprehensive clinical examination was conducted, covering vital signs, general physical examination, systemic examination, and relevant investigations such as FBS, RBS, PPBS, HbA1C, T3, T4, FT3, FT4, and TSH. Biochemical investigations were performed following proper aseptic techniques for blood collection. Patients were assessed for the presence of diabetes mellitus based on the ADA criteria for its diagnosis.

Guidelines for detection of Thyroid dysfunction [5]

- Normal–whenT3, T4 and TSH were in normal range
- Primary Hypothyroidism–when TSH more than 5.5mIU/ml and T3, T4 less than normal
- Primary Hyperthyroidism- when TSH is less than 0.3mIU/ml and T3, T4 more than normal.
- Subclinical Hypothyroidism–when TSH is more than 5.5mIU/ml andT3, T4 is within normal range.
- Subclinical Hyperthyroidism–when TSH is less than 0.3mIU/ml andT3, T4 is within normal range

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Normal values [5]

- FBS:70-100mg%
- PPBS:80-150mg%
- RBS:90-110mg%
- HbA1c:<6%
- TSH:0.35-4.94IU/ml
- T3:58-159ng/ml
- T4:4.7-11.7µg/dl
- FT3:1.71-3.71pg/dl
- FT4:0.7-1.48ng/dl

Data were analyzed using SPSS version 21.0, with descriptive statistics presented as mean, standard deviation, frequencies, and percentages. Student's t-test was applied to compare means, while the z-test for proportions and the Chi-square test were used for categorical variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1: Demographic Characteristics of Study Participants

Characteristics	Cases (n=170)	Control (n=50)	X^2 Value
	n (%)	n (%)	
Age group			
31-40 years	31 (18.2)	8 (16)	0.121
41-50 years	57 (33.5)	25 (50)	
51-60 years	50 (29.4)	10 (20)	
61-70 years	30 (17.6)	5 (10)	
71-80 years	2 (1.2)	2 (4)	
Gender			
Male	88(51.7)	35(70)	0.022
Female	82(48.2)	15(30)	
BMI			
Underweight (<18.5)	1(0.6)	0	0.130
Normal (18.5-22.9)	37(21.8)	19(38)	
Overweight (23 - 24.9)	35(20.6)	9(18)	
Obesity (≥ 25)	97(57.1)	22(44)	

In Table 1, the demographic characteristics of the study participants are presented. The mean age was 50±9.92 years and that the majority of both cases and controls fall within the 41-50 years group, with a higher percentage of controls in the 41-50 years category. Gender distribution shows a higher proportion of males in the control group, while females were more prevalent in the case group. Regarding BMI, the case group had a significantly higher percentage of participants classified as obese compared to the control group, suggesting a potential association between obesity and the studied condition.

Table 2: Distribution of Blood Glucose and HbA1C values among study participants

Tests	Group		p value
	Case	Control	
Fasting Blood Glucose (mg/dl)	156.45±6.3	91.88±7.3	**<0.001**
Post-prandial Blood Glucose (mg/dl)	246.98±9.2	111.50±7.9	**<0.001**

HbA1c (%)	7.094±1.4	5.050±0.9	<0.001

In Table 2, the distribution of blood glucose and HbA1c values among the study participants is presented. The fasting blood glucose, post-prandial blood glucose, and HbA1c levels were significantly higher in the case group (T2DM patients) compared to the control group (non-diabetic individuals), with p-values all less than 0.001. These findings highlight the significant differences in glycemic control between the two groups, with the case group exhibiting poorer glycemic control, as reflected by higher blood glucose and HbA1c levels.

Table 3: Distribution of Thyroid parameters among study participants.

Parameters	Group		P Value
	Case	Control	
Free T3 (pg/ml)	2.46±0.89	2.40±0.49	0.690
Free T4 (ng/ml)	1.38±0.43	1.32±0.29	0.385
TSH (μU/L)	4.36±6.03	2.85±2.33	0.085

In Table 3, the distribution of thyroid parameters among the study participants is shown. The mean values of Free T3, Free T4, and TSH levels did not differ significantly between the case group (T2DM patients) and the control group (non-diabetic individuals), with p-values of 0.690, 0.385, and 0.085, respectively. These results suggest that, despite the differences in the presence of diabetes, thyroid function parameters such as Free T3, Free T4, and TSH are comparable between the two groups.

Table 4: Comparison of Thyroid Biochemical Parameters between study groups.

Thyroid biochemical parameters		Case (n=170)	Control (n=50)	P Value
Free T3 (pg/ml)	Low (<1.4)	7(4.1%)	1(2%)	>0.05
	Normal (1.4 to 4.2)	161(94.7%)	49(98%)	
	High (>4.2)	2(1.2%)	0	
Free T4 (ng/ml)	Low (<0.8)	11(6.5%)	1(2%)	>0.05
	Normal (0.8 to 2)	156(91.8%)	49(98%)	
	High (>2)	3(1.8%)	0	
TSH (μU/L)	Low (<0.3)	3(1.8%)	0	***<0.05****
	Normal (0.3 to 4)	119(70.0%)	42(84%)	
	High (>4.00)	48(28.2%)	8(16%)	

In Table 4, the comparison of thyroid biochemical parameters between the study groups is presented. The distribution of Free T3 and Free T4 levels showed no significant differences between the case group (T2DM patients) and the control group (non-diabetic individuals), with p-values greater than 0.05 for both parameters. However, for TSH levels, a significant difference was observed ($p < 0.05$), with a higher percentage of individuals in the case group having high TSH levels compared to the control group. This suggests a notable prevalence of altered TSH levels in T2DM patients, indicating potential thyroid dysfunction in this population.

Table 5: Comparison of Thyroid Dysfunction between study groups

Classification	Case (n=170)	Control (n=50)	P Value
Normal	113(66.5%)	42(84.0%)	**<0.05**
Hypothyroidism	15(18.8%)	2(4.0%)	>0.05
Hyperthyroidism	6(3.5%)	0(0%)	>0.05
Subclinical Hypothyroidism	36(21.2%)	6(12.0%)	>0.05

In Table 5, the comparison of thyroid dysfunction between the study groups is presented. A significantly higher proportion of individuals in the case group (T2DM patients) had normal thyroid function compared to the control group ($p < 0.05$). However, the prevalence of hypothyroidism, hyperthyroidism, and subclinical hypothyroidism did not show significant differences between the groups, with p-values greater than 0.05 for all these categories. These findings suggest that while thyroid dysfunctions such as hypothyroidism and subclinical hypothyroidism were more common in the case group, the differences were not statistically significant.

Table 6: Distribution of Thyroid Disorder among Diabetic patients.

Thyroid Status	Gender		X^2 Value
	Male	Female	
Normal	68(77.3%)	45 (54.9%)	**0.017**
Hypothyroidism	4 (4.5%)	11 (13.4%)	
Hyperthyroidism	2 (2.3%)	4 (4.9%)	
Subclinical Hypothyroidism	14 (15.9%)	22 (26.8%)	

Table 6 shows the distribution of thyroid disorders among diabetic patients by gender. Subclinical hypothyroidism was higher in females (26.8%) than in males (15.9%). Hypothyroidism and hyperthyroidism were also more common in females, with a significant association between thyroid status and gender ($X^2 = 0.017$).

DISCUSSION

Insulin and thyroid hormones play a crucial role in regulating the metabolism of carbohydrates, proteins, and lipids, highlighting the interconnected relationship between diabetes mellitus (DM) and thyroid disorders [7]. In the present study the prevalence rate of Thyroid dysfunction was 33.5%, in which Hypothyroidism was 8.8%, Hyperthyroidism was 3.5%, and Sub-clinical Hypothyroidism was 21.2%. This is in contrast to a study by Athanasia et al [8] where the prevalence of thyroid dysfunction among Greek diabetic patients is 12.3%. Also, in a study by Ahmed et al [9], the prevalence rate of thyroid disorders in type 2 DM Libyan population was 9.5%, 5.0% is subclinical followed by 2.3% hypothyroidism and 2.2% hyperthyroidism. Jasim et al study in Kerala, South India showed that among all cases of type 2 diabetes mellitus, eight (16%) presented thyroid disorders [10, 11], Significant differences in TSH levels were observed between diabetic and non-diabetic patients in this study which is similar to findings reported by Vikram et al [12]. Thyroid dysfunction was more prevalent among female diabetic patients compared to males. This aligns with findings from Behera et al [13], where 23.4% of females were reported to have thyroid dysfunction.

In the current study, the majority of diabetic patients were found to be obese when compared to non-diabetic patients. This finding aligns with previous research by Jasim et al. and Kenigsberg et al, which reported a high prevalence of obesity among individuals with diabetes, likely attributable to insulin resistance associated with obesity [11, 14].

In this study, the mean HbA1C level was 7.094±1.4, which was higher compared to the control group. This finding is consistent with the study by Schlienger et al [15], which highlights that poor glycaemic control can lead to a "low T3 state" in individuals with Type 2 diabetes mellitus.

CONCLUSION

The study identified a significantly higher prevalence of hypothyroidism, particularly subclinical hypothyroidism, in patients with type 2 diabetes mellitus (T2DM). This underscores the potential link between thyroid dysfunction and T2DM, suggesting that thyroid abnormalities may contribute to the complexity of diabetes management. Given the impact of thyroid hormones on metabolic functions, routine screening for thyroid dysfunction in T2DM patients may help in early detection and better management of both conditions. Early identification of thyroid imbalances can potentially improve glycaemic control, reduce complications, and enhance overall patient outcomes. Regular monitoring of thyroid status in T2DM patients should therefore be considered an essential aspect of their comprehensive care. By integrating thyroid screening into routine diabetes management, healthcare providers can address potential comorbidities proactively, improving quality of life and long-term health outcomes.

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Limitations

Thyroid autoantibodies were not included in this study. Further research is needed to examine the role of thyroid antibodies, particularly considering the strong family history and high prevalence of thyroid dysfunction in this population. The small sample size and limited observation period also restrict the ability to draw definitive conclusions. A more comprehensive study with a larger sample size and extended follow-up period is required to provide more robust and informative findings.

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