ORIGINAL ARTICLE

Thyroid Profile in Type 2 Diabetes Mellitus and their Correlation

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ABSTRACT

Objective: To determine the association between thyroid disorders and type 2 diabetes mellitus (DM)
Methodology: A prospective case-control study was conducted at the National Medical Center, Karachi to find out the correlation analysis between studied parameters and type 2 diabetes (T2D).
Results: A positive correlation was observed between the cases and controls including age (0.180), fasting blood sugar (0.626), random blood sugar (0837), HbA1c (0.850), systolic blood pressure (0.281), diastolic blood pressure (0.166) and TSH levels (0.449). The correlation of RBS with HbA1c and TSH was positive and statistically significant ($p < 0.05$).
Conclusion: Individuals with type 2 diabetes are at higher risk to develop thyroid disorder specifically subclinical hypothyroidism because it is closely associated with glucose metabolism.

Keywords: Diabetes mellitus, hyperthyroidism, hypothyroidism, thyroid dysfunction, thyroid stimulating hormone

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INTRODUCTION

The prevalence of diabetes mellitus continues to rise and has become one of the most severe and costly chronic illnesses globally. Diabetes mellitus is a complex disease resulting from dynamic interactions between genetic, environmental, and other factors such as obesity and physical inactivity[1]. Thyroid hormones regulate both pancreatic and carbohydrate metabolism[2]. Diabetic patients with a history of hyperlipidemia, obesity, and anemia are at an increased risk of developing hypothyroidism. These comorbidities not only reduce patients' quality of life but also lead to higher medical costs, greater treatment complexity, and increased mortality[3]. Thyroid dysfunction has been reported to be associated with type 2 diabetes mellitus (T2DM) in various studies. Mild subclinical thyroid dysfunction has been linked to multiple complications such as chronic kidney disease and cardiovascular disease[4]. Thyroid hormones play an essential role in regulating carbohydrate metabolism and insulin secretion; therefore, alterations in the levels of one hormone can influence the effectiveness of the other. Individuals with type 2 diabetes mellitus have been found to have a significantly higher prevalence of thyroid disorders, with reported rates ranging between 9.9% and 48%[5]. According to the International Diabetes Federation (IDF), 537 million people worldwide were living with diabetes in 2021, a number projected to rise to 643 million by 2030 and 783 million by 2045. Recent studies have indicated that hypothyroidism affects approximately 6–24% of individuals with type 1 diabetes mellitus and 3–6% of those with type 2 diabetes mellitus[6]. According to Mehalingam et al., the prevalence of thyroid dysfunction among diabetic patients is 17.5%[7]. Diseases such as hypertension, obesity, and dyslipidemia, as well as other risk factors like cardiovascular disease, are more common among patients with type 2 diabetes and further increase the risk of heart attacks, especially in the presence of thyroid dysfunction. The increased risk of cardiovascular disease-related death observed in diabetic patients ranges from 1–3 times higher in males and 2–5 times higher in females. There is growing evidence that T2DM and thyroid dysfunction are interrelated.

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Diabetes can alter thyroid hormone metabolism and regulation through multiple physiological pathways, while thyroid dysfunction can worsen metabolic control and contribute to the progression of diabetes and its complications. Understanding the nature and extent of this relationship is important for improving disease management and patient outcomes. Therefore, this study seeks to determine the correlation between thyroid dysfunction and T2DM to better understand the mechanisms linking these two endocrine disorders[8].

METHODOLOGY

IRB/ERC Approval:

This was a prospective case control prospective study conducted at National Medical Centre, Karachi, from December 2022 to May 2023. Ethical approval was obtained from Ethical Review Committee of Bahria University of Health Sciences, Karachi Campus (Ref No: 112/2022) dated 19-12-2022 and informed consent was taken from all the participants. Total duration of study was 6 months after approval from Bahria university of Health sciences.

A total of 144 subjects were selected, including 72 diabetic patients and 72 non-diabetic subjects. Sample size was calculated through the open Epi software. All the participants were informed about the objective of the study and their participation in it. Thyroid function test was carried out by analyzing serum levels of thyroid profile and then compared in both cases and control. All participants had been diagnosed with T2DM for minimum two years and were receiving oral hypoglycemic agents, insulin, or a combination. Sampling technique was convenient. Subjects were medically examined including anthropometric values. Blood pressure measurements were taken using a mercury sphygmomanometer. Blood samples from the participants were analyzed for fasting blood sugar, random blood sugar, and HbA1c levels with the help of Roche 501 Routine Chemistry Analyzer.

Diabetic Patients over the age of 40 with a fasting blood sugar of =126 mg/dl, RBS levels >200 mg/dl and, HbA1c >6.5%, were included in this study. Exclusion criteria consisted of patients with history of type 1 diabetes mellitus, thyroid dysfunction, liver disease or renal disease, hypertension and pregnancy. Thyroid function test i.e. TSH was conducted with the help of Chemiluminescence Abbott 1000 ISR (Immunoassay Analyzer) on both groups. FT3 and FT4 were performed by Chemiluminescence Abbott 1000 ISR (Immunoassay Analyzer) in cases.

Data were stored and studied using IBM-SPSS version 23.0; Pearson chi square test was used to calculate the percentages which were reported on gender, marital status, education, exercise, diabetes, hypertension, diabetes duration, oral hypoglycemic, and outcome on FBS, RBS, HbA1c, TSH, FT3 and FT4 for cases and control samples. Spearman rank correlation analysis was done to study the relationship of studied parameters. Bar diagram was used to give graphical presentation of studied parameters.

RESULTS

In our study, we included 144 samples; with 50% in the cases group and 50% in the control group. In the control group, 69.4% were female, mean age was 49.1 years (SD=±7.8), 1.4% were single, 97.6% were married, 12.5% had primary education, 43.1% had secondary education, 41.7% were graduates, 2.8% held a masters degree, and 79.2% did no exercise. In the case group, 44.4% were female, mean age was 53.1 years (SD=±11.1), 2.8% were single, 94.4% were married, while 2.8% were widowed, 20.8% had primary education, 55.6% had received secondary education, 18.1% were graduates, and 5.6% were held a master degree. Additionally, 63.9% of case group did not exercise as reported in figure 1. Pearson Chi Square test did give a significant association of gender, age, education, exercise, and diabetic status with cases and control samples ($p<0.05$).

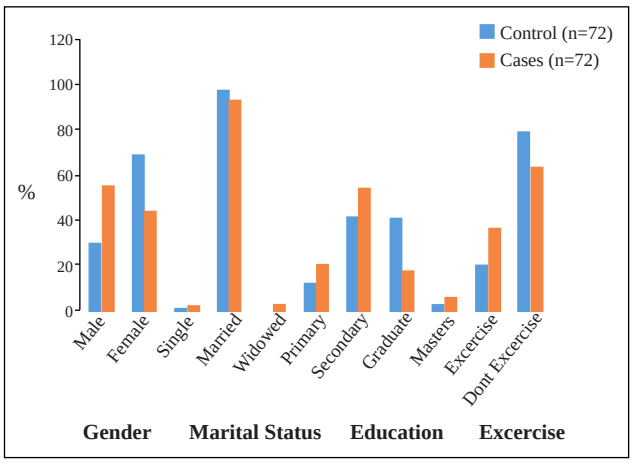

Figure 1: Base line characteristics of studied sample

In control group there were 97.22% normal FBS, 91.7% were normal RBS, all 100% were normal HbA1c, 98.6% were normal TSH and in cases 65.3% were normal FBS, 58.3% were normal RBS, 18.1% were normal HbA1c, 37.5% were normal TSH, 97.2% were normal FT3 and all 100% were normal FT4. Pearson Chi Square test did give a significant association of FBS, RBS, HbA1c, and TSH outcomes with cases and control samples ($p<0.05$) as shown in figure 2.

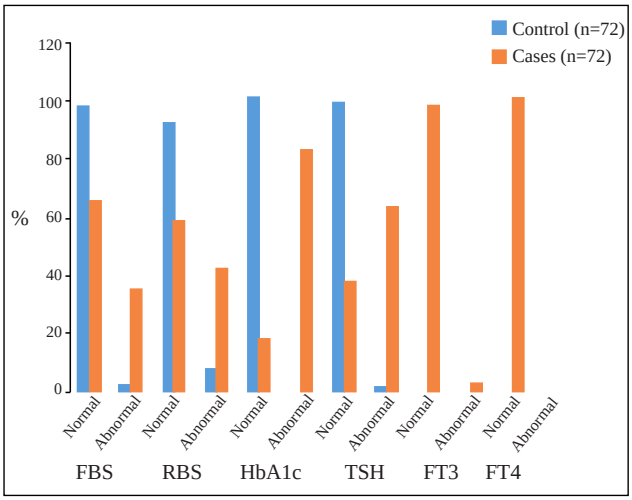

Figure 2: Outcomes on FBS, RBS, HbA1C, TSH, FT3 and FT4

Table-1 reports the detailed correlation analysis of studied parameters using Spearman Rank correlation with T2DM. Age, systolic blood pressure, diastolic blood pressure, fasting blood sugar, random blood sugar, HbA1c, and TSH showed a positive correlation with the cases, and these associations were statistically significant ($p < 0.05$). Age demonstrated a positive correlation with systolic blood pressure, random blood sugar, and TSH, but a negative correlation with BMI, all of which were statistically significant. Both systolic and diastolic blood pressure were positively correlated with BMI, fasting blood sugar, and HbA1c. Additionally, random blood sugar showed a positive and statistically significant correlation with both HbA1c and TSH.

DISCUSSION

Diabetes ranks as the third commanding cause of death worldwide, posing a significant threat to human health and placing a substantial burden on patients, their families, and society reference. Diabetes mellitus and thyroid disorders are the most common endocrinopathies, significantly affecting cardiovascular health[9]. In this study, the mean glycated hemoglobin in T2DM was 8.0 (SD+- 1.6), depicts poor glycemic control in T2DM patients. Our finding is coinciding with Alo et al[10]. Elevated HbA1c levels have been strongly associated with development of chronic complications in DM. Patients with T2DM with raised HbA1c were 4.3 times more likely to develop thyroid dysfunction compared to those with well controlled glycaemia (HbA1c <7%). This may be due to the adverse effects of chronic hyperglycemia on the hypothalamus-pituitary axis where it blunts or abolishes the nocturnal TSH peak[11].

Table-1: Correlation Analysis of Studied Parameters

Parameters		Group	Age	SBP	DBP	BMI	FBS	RBS	HbA1c (%)	TSH	FT3
Age	r-value	0.180	1.000								
	p-value	0.03*	-								
Gender	r-value	-0.252	-0.092								
	p-value	0.002*	0.273								
SBP	r-value	0.281	0.167	1.000							
	p-value	0.001*	0.046*	-							
DBP	r-value	0.166	0.045	0.461	1.000						
	p-value	0.047*	0.593	<0.01*	-						
BMI	r-value	0.112	-0.186	0.149	0.178	1.000					
	p-value	0.180	0.02*	0.075	0.03*	-					
FBS	r-value	0.626	-0.053	0.165	0.238	0.109	1.000				
	p-value	<0.01*	0.528	0.04*	<0.01*	0.192	-				
RBS	r-value	0.837	0.195	0.157	0.163	-0.02	0.617	1.000			
	p-value	<0.01*	0.01*	0.060	0.052	0.810	<0.01*	-			
HbA1c (%)	r-value	0.850	0.138	0.322	0.170	0.074	00.557	00.73	1.000		
	p-value	<0.01*	0.098	<0.01*	0.04*	00.378	<0.01*	<0.01*	-		
TSH	r-value	0.449	0.205	-0.032	0.026	-0.05	00.129	00.438	0.407	1.000	
	p-value	<0.01*	0.01*	0.705	0.760	00.529	00.123	<0.01*	<0.01*	-	
FT3	r-value	-	0.143	-0.007	-0.076	-0.07	-0.105	0.117	-0.075	-0.079	1.000
	p-value	-	0.230	0.956	0.524	00.51	00.379	0.328	0.532	0.508	-
FT4	r-value	-	0.090	-0.168	-0.128	-0.08	0.074	0.139	<0.01*	0.196	0.258
	p-value	-	0.452	0.159	0.283	0.47	0.535	0.244	0.974	0.099	0.02*

*Correlation with p<0.05 was considered statistically significant

In cases, the mean serum Fasting glucose, Random glucose and HbA1c levels among diabetic patients were 127.7 ± 53.0 mg/ dl, 235.5 ± 77.0 mg/dl, 8.0 ± 1.6%, For control participants, the parameters were within normal limits. Our findings are coinciding with the findings of Obgonna et al[11]. There was positive correlation between HbA1c, and TSH and this finding is coinciding with June et al[12]. In this study, we found higher BMI both in cases and control which is not supported by Hossain et al which found higher BMI in T2DM patients with thyroid dysfunction than without thyroid dysfunction. Zhu et al. found patients with BMI> 25 kg/m2 had increased risk of having subclinical hypothyroidism in diabetic patients[13].

In the present study, we observed that high serum TSH levels are another risk factor for increased glycemic variability. Among patients with T2DM but no evidence of thyroid disease, a higher serum TSH level was found to be closely associated with central obesity and hyperlipidemia[14]. Clinical and subclinical hypothyroidism increase risk of hypertension, heart failure, coronary artery disease related fatalities and overall mortality. Hypothyroidism treatment by supplementation of thyroid hormones can mitigate the cardiovascular risk. Obese diabetic individuals are at a greater risk of thyroid disease[15]. This is the first study which shows the correlation of T2DM with age, blood pressure, BMI, and with thyroid hormones simultaneously. The limitations of the study included its single-center design and small sample size. Additionally, FT3 and FT4 levels were not measured in the control group, and the relationship between diabetes-related complications and thyroid function status was not evaluated. Thyroid function in Type 2 Diabetic patients should be diagnosed early, and timely intervention should be performed if the levels of glycemic parameters were significantly increased as compared to non-diabetic subjects. People with Subclinical hypothyroidism may be at significantly increased risk of progression of T2DM, which requires clinical attention and effective prevention and treatment measures. Further follow-up study should be done in order to assess the importance of early identification of thyroid dysfunction, especially in its subclinical manifestation, and its enduring relationship with T2DM across diverse age, gender, and body mass index (BMI) categories. There is a requirement for extensive population-based longitudinal studies with extended observation periods. Follow-up studies in a cohort of subclinical hypothyroid patients with T2DM, need to be done to observe the complications in T2DM patients.

CONCLUSION

Patients with Type 2 diabetes Mellitus are more prone to develop thyroid disorder, specifically subclinical hypothyroidism, because it is closely associated with glucose metabolism. Regular screening of thyroid profile is recommended in routine medical practices for timely diagnosis of thyroid abnormalities in diabetics to lessen the risk of developing other associated morbidities.

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