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Prevalence and Impact of Thyroid Disorders on Glycemic Control in Patients with Type 2 Diabetes Mellitus: A Cross-Sectional Study

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Abstract

Objective: Diabetes and thyroid disorders (TD) are two prevalent endocrine conditions in adults. While the association between TD and type 1 diabetes is well documented, the relationship between type 2 diabetes mellitus (T2DM) and TD remains unclear due to its complex mechanisms and the involvement of multiple variables. This study aimed to evaluate the prevalence of TD in patients with T2DM referred to Yazd Diabetes Research Center in 2019.

Materials and Methods: This cross-sectional descriptive study included 411 patients with T2DM. Data were collected using a checklist comprising demographic information (age, sex, type of drug used, duration of diabetes) and clinical and laboratory information. Data were analyzed using SPSS version 24 software.

Results: Among the 411 patients with T2DM, 352 (85.6%) had no TD, 38 (9.24%) had hypothyroidism, and 21 (5.10%) had hyperthyroidism. There were no significant differences among groups in terms of gender (P= 0.269), age (P= 0.154), fasting blood sugar (FBS) level (P= 0.196), type of treatment (P= 0.9), and duration of T2DM (P= 0.138). However, a significant relationship was found between TD and the average level of glycosylated hemoglobin (HbA1c) (P= 0.021).

Conclusion: This study highlights a significant prevalence of TD among patients with T2DM, particularly noting the impact on HbA1c levels. Regular screening for TD in patients with T2DM is recommended to improve glycemic control and overall diabetes management. Further research is needed to elucidate the mechanisms linking TD and T2DM and to develop targeted interventions.

Keywords: Type 2 diabetics mellitus, Thyroid disorders, Glycated Hemoglobin A, Prevalence

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Introduction

Diabetes mellitus is acknowledged as a significant global public health issue, particularly in developing nations, because of its widespread occurrence, seriousness, and related complications. (1-3). Thyroid disorder (TD) and diabetes mellitus are the most common endocrine disorders that often coexist among individuals (4,5). Individuals with diabetes mellitus are susceptible to TD and patients with TD are susceptible to type 2 diabetes mellitus (T2DM) or T1DM (4,6).

TD is a spectrum of disorders of the thyroid gland that manifests either as hyper or hypothyroidism and is reflected in circulating levels of thyroid stimulating hormone (TSH) (7). Thyroid hormones cause an increase in the hepatocyte concentration of glucose-6-phosphate, glucose transporter 2 (GLUT 2) thereby leading to increased hepatic glucose. These hormones also cause an increase in gut glucose absorption and increased lipolysis which further promotes hepatic gluconeogenesis (8).

It has been detected that the prevalence of TD in the general population is between 6.6 and 13.4%. In contrast, the prevalence of TD in patients with diabetes is between 10 to 24% (9). However, in studies on TD and T2DM, conflicting results were obtained. In a study by Peross et al. in Scotland, the rate of hypothyroidism and hyperthyroidism in patients with diabetics was significantly higher than in the general population. In contrast, a study by Gopinat et al. in Australia showed that there was no significant difference between the incidence of TD in patients with diabetes compared to individuals without diabetes (10). These variations can be attributed to differing diagnostic standards for TD, varying levels of iodine consumption across regions, differences in the sensitivity of TSH tests, and the extensive diversity of populations. (9). Hence, assessment of thyroid function in individuals with diabetes may be helpful in the management of diabetes. Therefore, this study aimed to evaluate the prevalence of TD in patients with T2DM referred to Yazd Diabetes Research Center in 2019.

Material and methods

This cross-sectional study was conducted on individuals with T2DM referred to Yazd Diabetes Center in 2019. Using the estimation formula one, the alpha ratio of 0.05, and the prevalence of 48%, the sample size was initially estimated to be 400. However, using a random number table, 411 patients were randomly selected. Inclusion criteria included patients aged 35-65 with an active file at this center and a definitive diagnosis of T2DM made by a specialist physician. Exclusion criteria included patients with T1DM and pregnant women. Data collection was done using a checklist consisting of two parts: the first covered demographic information such as age, sex, and duration of diabetes; the second part included patients' clinical and laboratory information. Then we evaluated the association of these factors with TD in the diabetic population. Diabetes mellitus was defined for individuals with a fasting blood sugar (FBS) greater than or equal to 126 mg/dL, a Glucose Tolerance Test (GTT) greater than or equal to 200 mg/dL, HbA1c greater than 6.5%, or a plasma glucose concentration in a random sample greater than or equal to 200 mg/dL, accompanied by the classic symptoms of diabetes. The diagnostic criteria for TD were TSH levels greater than 5 or less than 0.4 (according to the endocrinologist). Chi-square test and ANOVA were conducted, with a significance level set at $P< 0.05$.

Ethical considerations

The study was approved by the ethics committee of Shahid Sadoughi University of Medical Sciences, Yazd, Iran with the code number of IR.SSU.MEDICINE.REC.1398.

026. All collected information was kept confidential and anonymous.

Results

In the present study, 411 patients with T2DM referred to Yazd Diabetes Research Center with a mean (±SD) age of 56.7 (±10.6), including 253 (61.6%) women. Of these, 384 (7.84%) were on oral medication and 63 (15.3%) were on insulin therapy. The frequency of TD was 21 patients with hyperthyroidism (5.10%) and 38 patients with hypothyroidism (9.24%). Duration of diabetes, FBS, HbA1c, and thyroid hormone levels including TSH and T4 were studied (Table 1).

As shown in Table 2, our results showed that there was no significant difference among groups in terms of gender (*P*= 0.269), age (*P*= 0.154), type of treatment (*P*= 0.9), FBS (*P*= 0.196), and duration of diabetes (*P*= 0.138). However, the mean (±SD) level of HbA1c was significantly difference in patients with hypothyroidism, hyperthyroidism, and T2DM without TD. In other words, individuals with T2DM without TD had a lower HbA1c than those with T2DM and TD.

Discussion

This study evaluated the prevalence and characteristics of TD among individuals with T2DM referred to Yazd Diabetes Center in 2019. A total of 411 patients, aged 35-65 years, were randomly selected for this cross-sectional analysis. Among 411 patients with T2DM, 14.3% had also TD.

Our analysis also indicated no significant difference in gender distribution among the groups. In several studies, it has been shown that gender is a risk factor for TD among patients with diabetes and the prevalence of TD in women with diabetes is significantly higher than in men (11–13). However, other studies have reported a higher prevalence of TD in females with diabetes, likely due to the higher overall prevalence of thyroid diseases in women. According to the results of this study, the average age of T2DM patients separately, including hypothyroidism, normal, and hyperthyroidism, was 55.07, 56.8, and 60.4 years, respectively, and there was no statistically significant difference between the prevalence of TD according to age. Align with this study, Ozair et al. reported that there was no significant relationship between age and T2DM patients with TD (14). The absence of a

Table 1. Values are reported as average (± SD) or content (percentage)

Parameters		*P*-value
Age (year)		56.7 (±10.6)
Gender	Male	253 (61.6%)
	Female	158 (38.4%)
Type of treatment	Oral	348 (84.7%)
	Insulin	63 (15.3%)
Duration of diabetes (year)		6.30 (±6.7)
FBS (mg/dl)		172.5 (±64.6)
HbA1C (%)		8.04 (±1.7)
TSH (mlU/L)		2.31 (±3.01)
T4(mIU/L)		9.5 (±8.6)

Table 2. Characteristics of study sample for individuals with T2DM with or without TD

Parameters		Hyperthyroidism (n=21)	Hypothyroidism (n=38)	T2DM without TD (n=352)	*P*-value
Gender	Male	10 (6.3%)	8 (5.1%)	140 (88.6%)	0.269
	Female	28 (11.1%)	13 (5.1%)	212 (83.8%)	
Age		60.4 (±2.46)	55.07 (±1.56)	56.8 (±0.54)	0.154
Type of treatment	oral	3 (4.8%)	5 (7.9%)	55 (87.3)	0.9
	insulin	18 (5.2%)	33 (9.5%)	297 (85.3%)	
FBS (mg/dl)		164.61 (±14.43)	189.97 (±13.97)	171.13 (±3.31)	0.196
HbA1c (%)		8.07 (±0.43)	8.8 (±0.33)	7.95 (±0.091)	0.021
Duration of diabetes (years)		4.2 (±1.01)	5 (±0.77)	6.57 (±0.37)	0.138

significant age difference might reflect the relatively narrow age range of the study participants, which may not capture potential variations seen in broader or different age groups.

The study also found no significant differences in the type of diabetes treatment and the duration of diabetes between the groups. This finding suggests that the type of diabetes treatment, whether oral hypoglycemics or insulin, and the length of time a person has had diabetes, do not significantly influence the development of TD in this study. This contrasts with some reports suggesting that a longer duration of diabetes could be associated with a higher risk of developing TD due to prolonged metabolic stress and potential autoimmune interactions over time.

On the other side, one of the risk factors of TD is the duration of diabetes. As it has been shown in the study of Al-Geffari et al., the duration of more than ten years of diabetes is one of the influencing factors on TD (4) while in Stanley et al.'s study, the duration of diabetes of more than 5 years was associated with the occurrence of TD (11). However, according to the results of this study, no significant relationship was observed in terms of the duration of diabetes among the groups. Aligning with our research, some studies reported that there was no relationship between the duration of diabetes and the prevalence of TD in individuals who suffer from diabetes (12,15).

The levels were not significantly different among the groups (P= 0.196), indicating that FBS may not be a reliable marker to distinguish between T2DM patients with and without thyroid dysfunction. This finding underscores the complexity of glucose metabolism in the presence of TD, where other factors such as insulin sensitivity and beta-cell function might play more critical roles.

Interestingly, the study revealed a significant difference in HbA1c levels among the groups. Patients with T2DM without TD had lower HbA1c levels compared to those with T2DM and either hypothyroidism or hyperthyroidism. This is a crucial finding as it highlights the potential impact of thyroid dysfunction on glycemic control in diabetic patients. Hypothyroidism is known to decrease metabolic rate and can contribute to hyperglycemia by impairing insulin sensitivity and reducing the clearance of insulin (16,17). This can lead to elevated HbA1c levels, reflecting poorer glycemic control. Conversely, hyperthyroidism increases metabolic rate and insulin clearance, potentially leading to fluctuating blood glucose levels and poor glycemic control, which can also be reflected in higher HbA1c levels (6,18).

The observed higher HbA1c levels in patients with TD emphasize the need for rigorous monitoring and management of glycemic control in diabetic patients with TD. The interplay between thyroid hormones and glucose metabolism suggests that thyroid function should be regularly assessed in diabetic patients to identify and manage thyroid dysfunction early.

The findings of this study have several clinical implications. First, they reinforce the importance of screening for TD in patients with T2DM, given the significant impact on glycemic control. Regular screening can facilitate early detection and treatment of TD, potentially improving overall diabetes management and reducing complications (19). Second, the significant difference in HbA1c levels observed in this study suggests that clinicians should be aware of the potential for thyroid dysfunction to complicate diabetes management. This awareness is critical in achieving personalized patient care and improving long-term outcomes (20).

Despite its strengths, this study has several limitations. The cross-sectional design limits the ability to establish causal relationships between T2DM and thyroid dysfunction. Longitudinal studies are needed to better understand the temporal relationship and causality. Additionally, the study population was limited to a specific geographic area,

which may affect the generalizability of the findings to other populations. The relatively narrow age range of the participants may also limit the applicability of the results to younger or older diabetic patients.

Conclusion

In conclusion, this study highlights the significant prevalence and impact of TD in patients with T2DM. While demographic factors such as age and gender did not significantly differ among the groups, the presence of TD was associated with higher HbA1c levels, indicating poorer glycemic control. These findings underscore the importance of routine thyroid function screening and comprehensive management strategies in diabetic patients to optimize clinical outcomes and mitigate complications associated with both diabetes and TD. Further research is warranted to explore the mechanisms underlying the interaction between TD and diabetes and to develop targeted interventions for this comorbid population.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

Authors' contributions

M.S. was responsible for collecting data and contributed significantly to the writing of the original draft of the manuscript. N.I. and H.N. played a pivotal role in the collection of data and development of the research methodology. R.A. supervised the clinical aspects of the study, ensuring accurate diagnosis and treatment of patients. N.N. supervised the clinical aspects of the study, performed the data analysis, and interpreted the results. All authors read and approved the final manuscript.

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