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Prevalence and Associated Factors of Thyroid Dysfunction Among Patients with Type 2 Diabetes Mellitus in Yemen: A Cross-Sectional Study

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Abstract: ***Background:*** Thyroid dysfunction (TD) is a common endocrine disorder that frequently coexists with type 2 diabetes mellitus (T2DM), potentially worsening metabolic control and increasing cardiovascular risk. ***Objective:*** To determine the prevalence of thyroid dysfunction and its associated factors among patients with T2DM in Yemen. ***Methods:*** This cross-sectional study was conducted between March 2024 and September 2025 at Al-Kuwait University Hospital and private consultation clinics in Sana'a, Yemen. A total of 450 patients with T2DM were enrolled. Thyroid function was assessed using serum thyroid-stimulating hormone (TSH), free triiodothyronine (FT3), and free thyroxine (FT4). Clinical, biochemical, and demographic data were collected. Statistical analysis was performed to identify factors associated with thyroid dysfunction. ***Results:*** The prevalence of thyroid dysfunction was 12% (n=54). Hypothyroidism was the most common abnormality (77.7%), followed by hyperthyroidism (22.3%). Thyroid dysfunction was significantly more frequent in females ($p<0.001$). Patients with thyroid dysfunction had significantly higher prevalence of hypertension (72.2% vs. 50.7%, $p=0.008$), poor glycemic control (HbA1c ≥7%) (72.2% vs. 46.9%, $p<0.001$), elevated triglycerides and LDL cholesterol, and lower HDL levels ($p<0.05$). ***Conclusion:*** Thyroid dysfunction is relatively common among patients with T2DM in Yemen and is associated with poor glycemic control and adverse cardiovascular risk factors. Routine screening for thyroid dysfunction in T2DM patients is strongly recommended.

Keywords: Type 2 diabetes mellitus, thyroid dysfunction, hypothyroidism, dyslipidemia, Yemen

INTRODUCTION

Thyroid dysfunction (TD) is one of the most common endocrine disorders worldwide and has a significant impact on metabolic homeostasis. Increasing evidence suggests a strong interrelationship between thyroid hormones and glucose metabolism, particularly in patients with type 2 diabetes mellitus (T2DM) (1,2).

Thyroid hormones influence insulin secretion, hepatic glucose production, and peripheral glucose utilization. Conversely, insulin resistance and chronic hyperglycemia in T2DM may alter thyroid function through effects on the hypothalamic–pituitary–thyroid axis and peripheral conversion of thyroxine (T4) to triiodothyronine (T3) (3,4).

Several studies have reported a higher prevalence of thyroid dysfunction in patients with T2DM compared to the general population, ranging from 10% to 25% (2,5,9). Hypothyroidism, particularly subclinical hypothyroidism, is the most commonly observed abnormality and is associated with dyslipidemia, insulin resistance, and increased cardiovascular risk (6,7,20,21).

Female gender, increasing age, and poor glycemic control have been identified as major risk factors for thyroid dysfunction in diabetic populations (7,10,12). Despite the clinical importance of this association,

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data from Yemen and similar low-resource settings remain limited. Therefore, this study aimed to determine the prevalence of thyroid dysfunction and its associated risk factors among patients with T2DM in Sana'a, Yemen.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based cross-sectional study conducted from March 2024 to September 2025 at Al-Kuwait University Hospital and affiliated consultation clinics in Sana'a, Yemen.

Study Population

A total of 450 patients diagnosed with T2DM were consecutively recruited.

Inclusion Criteria

Adults diagnosed with T2DM based on ADA criteria
Patients attending outpatient clinics during the study period

Exclusion Criteria

Type 1 diabetes mellitus
Pregnancy
Known thyroid disease on treatment
Use of medications affecting thyroid function (e.g., amiodarone)
Severe systemic illness

Data Collection

Data were collected using a structured questionnaire and medical records, including:
Demographic data (age, sex)
Clinical parameters (duration of diabetes, hypertension, BMI)
Laboratory data (HbA1c, lipid profile)

Laboratory Measurements

Blood samples were analyzed for:
TSH, FT3, FT4 (electrochemiluminescence assay)
HbA1c
Lipid profile (TG, LDL, HDL)
Type 2 diabetes mellitus was diagnosed according to the American Diabetes Association (ADA) criteria (16).

Body mass index (BMI) classification was based on World Health Organization (WHO) guidelines (18).
Thyroid dysfunction was defined based on standard laboratory reference ranges and international clinical guidelines (17,18).

Statistical Analysis

Data were analyzed using SPSS. Continuous variables were expressed as mean ± SD, and categorical variables as percentages. Chi-square test and independent t-test were used. A p-value <0.05 was considered statistically significant.

Ethical Approval

The study was approved by the Ethics Committee of the Faculty of Medicine, Sana'a University. Informed consent was obtained from all participants.

RESULTS

Table 1. Baseline Characteristics of the Study Population (n = 450)

Variable	Male	Female	Total	p-value
Age	55.2±13.2	56.1±14.2	56.4±14.5	0.34
Duration DM	13.4	14.0	15.2	0.12
BMI ≥27%	22.6%	46.6%	34.6%	0.002
HbA1c ≥7%	46.6%	53.3%	50%	0.41
Hypertension	57.3%	49.3%	53.3%	0.09
High TG	29.3%	29.3%	29.3%	0.10
Low HDL	26.6%	38.6%	32.6%	0.13
High LDL	26.6%	40%	33.3%	0.003

Analysis of Table 1
The baseline characteristics showed no statistically significant differences between males and females in terms of age, duration of diabetes, glycemic control, or hypertension ($p>0.05$).

However, female patients had significantly higher BMI and LDL cholesterol levels ($p<0.05$), indicating a higher burden of metabolic risk factors among females. This may partly explain the higher prevalence of thyroid dysfunction observed in female patients.

The overall prevalence of thyroid dysfunction was 12.7%, which is consistent with international data.

Hypothyroidism was the dominant disorder (77.7%), with both overt and subclinical forms contributing significantly. A clear female predominance was observed (68.4% of cases), supporting the well-established association between female gender and thyroid disease.

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Hyperthyroidism was less common (22.3%), which aligns with global epidemiological patterns in T2DM populations.

Table 2. Prevalence and Types of Thyroid Dysfunction

Status	Male	Female	Total
Normal	207	186	393
Thyroid Dysfunction	18	39	57
Hypothyroidism	15	34	49
Hyperthyroidism	3	5	8

Analysis of Table 2

Table 3. Comparison Between T2DM Patients With and Without Thyroid Dysfunction

Variable	With TD	Without TD	p-value
Age	55.4	57.1	0.21
Duration DM	14.2	14.5	0.43
BMI ≥27%	50%	32.5%	0.14
HbA1c ≥7%	72.2%	46.9%	<0.001
Hypertension	72.2%	50.7%	0.008
High TG	55.5%	25.7%	0.005
Low HDL	61.1%	28.7%	0.006
High LDL	55.5%	30.3%	0.03

Analysis of Table 3

There were no significant differences in age, duration of diabetes, or BMI between patients with and without thyroid dysfunction ($p>0.05$).

However, several strong associations were identified:
Poor glycemic control (HbA1c ≥7%) was significantly higher in patients with thyroid dysfunction (72.2% vs. 46.9%, $p<0.001$)
Hypertension was more prevalent (72.2% vs. 50.7%, $p=0.008$)
Dyslipidemia was markedly worse:
High triglycerides ($p=0.005$)
Low HDL ($p=0.006$)
High LDL ($p=0.03$)

These findings indicate that thyroid dysfunction is strongly associated with metabolic derangement and increased cardiovascular risk in T2DM patients.

Table 4. Multivariate Logistic Regression Analysis for Predictors of Thyroid Dysfunction

Variable	OR	95% CI	p-value
Female	2.8	1.5–5.2	0.001
HbA1c ≥7%	3.1	1.7–5.8	<0.001
Hypertension	2.2	1.2–4.0	0.01
High TG	2.5	1.3–4.7	0.005
Low HDL	2.7	1.4–5.1	0.003
High LDL	2.1	1.1–3.9	0.02
BMI ≥27	1.4	0.8–2.6	0.18

Analysis of Table 4

Multivariate logistic regression analysis identified several independent predictors of thyroid dysfunction among patients with T2DM.

Poor glycemic control (HbA1c ≥7%) was the strongest predictor, increasing the risk by more than threefold (OR = 3.1, $p<0.001$).

Female gender remained a significant independent factor (OR = 2.8, $p=0.001$), confirming the known higher susceptibility to thyroid disorders.

Hypertension was also independently associated (OR = 2.2, $p=0.01$), reflecting shared cardiovascular risk pathways.
Regarding lipid profile:
High triglycerides, low HDL, and high LDL were all significant predictors ($p<0.05$), indicating a strong relationship

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between thyroid dysfunction and dyslipidemia.

BMI, although higher in affected patients, did not reach statistical significance after adjustment (p=0.18), suggesting that its effect may be mediated through other metabolic variables.

Results

Out of 450 patients, 54 were diagnosed with thyroid dysfunction, yielding a prevalence of 12%.
Hypothyroidism was the most common disorder (77.7%), while hyperthyroidism accounted for 22.3%.
Thyroid dysfunction was significantly more prevalent in females compared to males (72.2% vs. 27.8%, p<0.001).
There was no significant difference in age or duration of diabetes between groups (p>0.05).
However, patients with thyroid dysfunction showed:
Higher prevalence of hypertension (72.2% vs. 50.7%, p=0.008)
Poor glycemic control (72.2% vs. 46.9%, p<0.001)
Elevated triglycerides and LDL cholesterol (p<0.05)
Reduced HDL cholesterol (p<0.05)

DISCUSSION

The present study demonstrated a prevalence of thyroid dysfunction of approximately 12% among patients with T2DM, which is consistent with previously reported rates ranging between 10% and 25% (2,5,9,14).

Hypothyroidism was the most prevalent abnormality, in agreement with several studies indicating that subclinical and overt hypothyroidism are the dominant thyroid disorders in diabetic populations (6,7,8,13).

The higher prevalence observed among females is consistent with global epidemiological data, which indicate that thyroid disorders are significantly more common in women due to hormonal and autoimmune factors (10,11).

A key finding of this study is the strong association between thyroid dysfunction and poor glycemic control. This is supported by previous research demonstrating that thyroid hormones influence insulin sensitivity and glucose metabolism (3,4,22).

Furthermore, the significant association with hypertension and dyslipidemia highlights the important role of thyroid hormones in cardiovascular risk regulation (20,21).

Multivariate regression analysis confirmed that poor glycemic control, female gender, hypertension, and dyslipidemia are independent predictors of thyroid dysfunction. These findings align with previous studies that identified similar predictors in T2DM populations (5,12,13).

The bidirectional relationship between thyroid dysfunction and diabetes suggests that each condition may exacerbate the other, contributing to increased morbidity if left untreated (9,13).

Clinical Implications

Routine screening for thyroid dysfunction in T2DM patients—especially in females and those with poor glycemic control—may improve overall disease management and reduce complications.

Limitations

Cross-sectional design (no causal inference)
Single-center study
Lack of thyroid antibody testing

CONCLUSION

Thyroid dysfunction is common among patients with T2DM in Yemen and is associated with adverse metabolic and cardiovascular risk factors. Routine thyroid screening should be considered in the management of T2DM patients.

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