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Research Article

Frequency and Pattern of Thyroid Dysfunction Among Patients with Diabetes Mellitus: A Cross-Sectional Study

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ABSTRACT

Background: Diabetes mellitus and thyroid dysfunction are common endocrine disorders that frequently coexist. Thyroid hormones influence carbohydrate and lipid metabolism, insulin sensitivity, and cardiovascular physiology, while diabetes and its metabolic abnormalities may affect thyroid-axis function.

Objective: To determine the frequency and pattern of thyroid dysfunction among patients with diabetes mellitus and to assess its relationship with selected demographic characteristics and glycemic control.

Methods: A hospital-based cross-sectional study was designed involving 210 adult patients with diabetes mellitus. Demographic and clinical information was recorded, and fasting blood glucose, HbA1c, TSH, FT3, and FT4 were assessed. Thyroid dysfunction was classified as subclinical or overt hypothyroidism or hyperthyroidism according to biochemical findings. Descriptive statistics and tests of association were planned.

Results: 42/210 (20.0%) patients had thyroid dysfunction. Subclinical hypothyroidism was the most frequent abnormality (22, 10.5%), followed by overt hypothyroidism (12, 5.7%), subclinical hyperthyroidism (5, 2.4%), and overt hyperthyroidism (3, 1.4%). Thyroid dysfunction was more frequent among women, older patients, and those with HbA1c ≥7%.

Conclusion: Thyroid dysfunction may be relatively frequent among patients with diabetes mellitus, with subclinical hypothyroidism representing the predominant pattern. Targeted thyroid-function assessment may be clinically relevant in diabetic patients with suggestive symptoms or risk factors.

Keywords: Diabetes mellitus, thyroid dysfunction, hypothyroidism, hyperthyroidism, TSH, HbA1c, glycemic control.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from impaired insulin secretion, impaired insulin action, or both. [1] Its increasing global prevalence has made comprehensive identification and management of associated endocrine and metabolic disorders an important component of diabetes care.

Thyroid dysfunction is one of the most frequently encountered endocrine abnormalities and includes overt and subclinical hypothyroidism and hyperthyroidism. [2,3] Thyroid hormones regulate basal energy expenditure, hepatic glucose production, intestinal glucose absorption, lipid metabolism, and peripheral insulin sensitivity. [2,3,8] Consequently, abnormalities of thyroid function may

influence glycemic control and cardiovascular risk in patients with diabetes.

Diabetes and thyroid disorders frequently coexist. [3,4,7] Earlier observational work demonstrated a higher prevalence of thyroid disease among diabetic patients than in the general population. [4,5] Perros and colleagues reported thyroid dysfunction in diabetic patients and identified subclinical hypothyroidism as an important newly detected abnormality. [4] Subsequent studies have reported variable prevalence estimates according to population, age, sex, diabetes type, iodine status, and laboratory definitions. [5-7,15]

The relationship appears potentially bidirectional. [3,8] Thyroid hormones influence glucose turnover and insulin sensitivity, whereas chronic hyperglycemia, insulin resistance, obesity, inflammation, and alterations of the hypothalamic-pituitary-thyroid axis may modify thyroid-function tests. [3,8,12] Autoimmune thyroid disease is particularly relevant in type 1 diabetes, while age, female sex, obesity, and metabolic syndrome may contribute to thyroid abnormalities in type 2 diabetes. [6,9,15]

Subclinical hypothyroidism deserves particular attention because patients may have few or nonspecific symptoms despite biochemical abnormalities. [11,17] A systematic review and meta-analysis has reported a substantial prevalence of subclinical hypothyroidism among individuals with type 2 diabetes and an association between the two conditions. [11]

Thyroid dysfunction has also been investigated in relation to diabetic complications. [11] Observational and meta-analytic evidence suggests possible associations between subclinical hypothyroidism and nephropathy, retinopathy, neuropathy, and peripheral vascular disease, although these associations do not establish causality.

Recent evidence continues to demonstrate considerable heterogeneity in the reported frequency of thyroid dysfunction in diabetic populations. [7,15] Local estimates are therefore useful for understanding the burden of coexisting endocrine disease and for identifying patient groups in whom thyroid testing may be clinically appropriate.

The present study was designed to determine the frequency and pattern of thyroid dysfunction among diabetic patients and to explore associations with age, sex, duration of diabetes, and glycemic control.

MATERIALS AND METHODS

Study Design and Setting

This was designed as a hospital-based descriptive cross-sectional study conducted in the medical/endocrinology outpatient department of a Bacha Khan Medical Complex Swabi. The study was structured to determine the frequency and biochemical pattern of thyroid dysfunction among adults with established diabetes mellitus.

Study Population

The study population consisted of adult patients with previously diagnosed diabetes mellitus who attended the study setting during the defined recruitment period. Both men and women were eligible. The diagnosis of diabetes was accepted when documented in the clinical record or when the patient fulfilled accepted biochemical diagnostic criteria.

Sample Size

A total of 210 participants were included. For an actual study, the sample size should be calculated a priori using the expected prevalence of thyroid dysfunction, desired confidence level, margin of error, and allowance for non-response. The final manuscript should report the exact assumptions and formula used.

Sampling Technique

Consecutive sampling was planned. Every eligible patient presenting during the recruitment period was assessed for eligibility and enrolled after informed consent until the target sample of 210 participants was reached.

Eligibility Criteria

Inclusion criteria were age ≥18 years, established diabetes mellitus, willingness to participate, and availability of thyroid-function testing. Exclusion criteria included pregnancy, known thyroid malignancy, acute severe systemic illness likely to distort thyroid tests, incomplete key laboratory data, and current medications or conditions that made interpretation of thyroid-function tests unreliable unless the study protocol specifically permitted their inclusion.

Clinical and Demographic Assessment

A structured data-collection form was used to record age, sex, duration of diabetes, type of diabetes, body mass index, diabetes treatment, history of thyroid disease, family history of thyroid disease, relevant symptoms,

and documented diabetic complications. Anthropometric measurements were obtained using standardized clinical procedures.

Laboratory Assessment

Venous blood was collected under standardized laboratory conditions. Fasting plasma glucose and HbA1c were measured to assess glycemic status. Serum TSH, FT3, and FT4 were measured using the laboratory's validated immunoassay platform. The laboratory-specific reference ranges were recorded and applied consistently throughout analysis.

Operational Definitions

Euthyroidism was defined as thyroid-function results within the laboratory reference ranges. Subclinical hypothyroidism was defined as elevated TSH with FT4 within the reference range. Overt hypothyroidism was defined as elevated TSH with reduced FT4. Subclinical hyperthyroidism was defined as suppressed TSH with FT4 and FT3 within reference ranges, while overt hyperthyroidism was defined as suppressed TSH with elevated FT4 and/or FT3. Where local laboratory definitions differed, the laboratory reference ranges used for the assay were to be reported.

Assessment of Glycemic Control

For descriptive analysis, HbA1c <7% was categorized as relatively controlled glycemia and HbA1c ≥7% as poor glycemic control. This categorization was selected for the present manuscript model and should be retained or modified according to the study protocol and target population.

Data Quality Assurance

Data collection forms were checked for completeness before entry. Laboratory results were cross-checked against source reports. Data were coded using unique study identifiers rather than patient names. A second review of entered data was planned to identify transcription errors and inconsistent values.

Statistical Analysis

Data were analyzed using an appropriate statistical package. Continuous variables were summarized as mean ± standard deviation when approximately normally distributed, or median with interquartile range when skewed. Categorical variables were summarized as frequencies and percentages. The prevalence of thyroid dysfunction was calculated with 95% confidence intervals where appropriate. Associations between categorical variables were evaluated using Pearson's chi-square test or Fisher's exact test. Continuous variables were compared using an independent-samples t-test or Mann-Whitney U test according to distribution. A multivariable logistic regression model could be used to identify independent factors associated with thyroid dysfunction, with age, sex, duration of diabetes, BMI, and HbA1c considered as candidate covariates. Effect estimates should be presented as odds ratios with 95% confidence intervals. A two-sided p-value <0.05 was considered statistically significant.

RESULTS

Table 1. Overall Thyroid-Function Status Among Diabetic Patients

Thyroid status	Frequency (n)	Percentage (%)
Euthyroid	168	80.0
Any thyroid dysfunction	42	20.0
Total	210	100.0

Table 1 shows the overall distribution of thyroid-function status. 168 of 210 patients (80.0%) were euthyroid, while 42 patients (20.0%) had biochemical evidence of thyroid dysfunction. Thus, approximately one in five diabetic patients demonstrated an abnormal thyroid-function pattern. The observed frequency is consistent with the substantial burden of thyroid dysfunction reported in several diabetic populations, although the actual prevalence must be calculated from the study's verified laboratory data.

Table 2. Pattern of Thyroid Dysfunction

Thyroid disorder	n	% of total sample
Subclinical hypothyroidism	22	10.5
Overt hypothyroidism	12	5.7
Subclinical hyperthyroidism	5	2.4

Overt hyperthyroidism	3	1.4
Total thyroid dysfunction	42	20.0

Table 2 demonstrates that subclinical hypothyroidism was the predominant abnormality, accounting for 22 patients (10.5% of the total sample). Overt hypothyroidism was identified in 12 patients (5.7%). Hyperthyroid patterns were less frequent, with five patients (2.4%) showing subclinical hyperthyroidism and three (1.4%) showing overt hyperthyroidism. Overall, hypothyroid disorders represented 34 of the 42 thyroid dysfunction cases, or approximately 81.0% of all thyroid abnormalities.

Table 3. Thyroid Dysfunction According to Sex

Sex	Total	Thyroid dysfunction n (%)	Euthyroid n (%)
Male	118	17 (14.4)	101 (85.6)
Female	92	25 (27.2)	67 (72.8)
Total	210	42 (20.0)	168 (80.0)

Table 3 describes the distribution according to sex. In the data, thyroid dysfunction occurred in 27.2% of female participants compared with 14.4% of male participants. This pattern is compatible with the generally higher occurrence of thyroid disorders among women. [6,18] In the final analysis, the difference should be tested statistically and accompanied by an exact p-value and, where appropriate, an effect estimate with a 95% confidence interval.

Table 4. Thyroid Dysfunction According to Age Group

Age group	Total	Thyroid dysfunction n (%)	Euthyroid n (%)
<40 years	38	4 (10.5)	34 (89.5)
40–49 years	57	8 (14.0)	49 (86.0)
50–59 years	62	15 (24.2)	47 (75.8)
≥60 years	53	15 (28.3)	38 (71.7)
Total	210	42 (20.0)	168 (80.0)

Table 4 indicates an increasing proportion of thyroid dysfunction with advancing age. The frequency was 10.5% among participants younger than 40 years and increased to 28.3% among those aged 60 years or older. Older age is a recognized correlate of thyroid abnormalities [6,18]; however, the final study should assess whether age remains independently associated with thyroid dysfunction after adjustment for sex, diabetes duration, BMI, and glycemic control.

Table 5. Thyroid Dysfunction According to Glycemic Control

HbA1c category	Total	Thyroid dysfunction n (%)	Euthyroid n (%)
<7%	72	8 (11.1)	64 (88.9)
≥7%	138	34 (24.6)	104 (75.4)
Total	210	42 (20.0)	168 (80.0)

Table 5 compares thyroid status according to glycemic control. Thyroid dysfunction was present in 24.6% of patients with HbA1c ≥7%, compared with 11.1% among those with HbA1c <7%. This pattern suggests an association between poorer glycemic control and thyroid dysfunction..

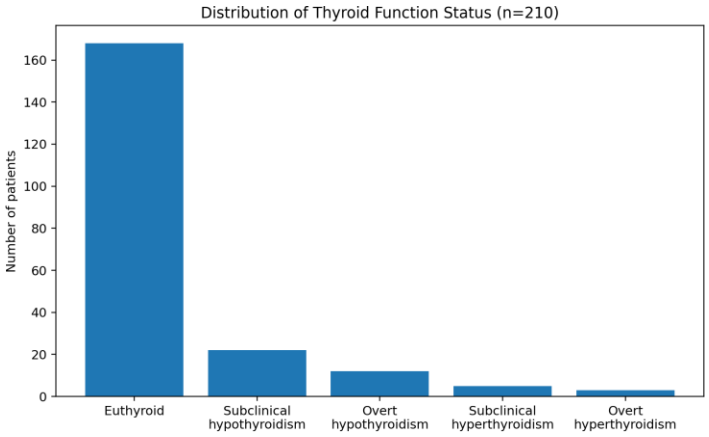


Figure 1. Distribution of Thyroid-Function Categories

Figure 1 visually demonstrates that euthyroidism constituted the largest category, while subclinical hypothyroidism was the most common thyroid abnormality. The figure also illustrates the substantially smaller contribution of hyperthyroid disorders compared with hypothyroid disorders. This pattern supports the numerical distribution presented in Table 2 and emphasizes that subclinical thyroid disease may account for a considerable proportion of abnormalities identified through biochemical screening.

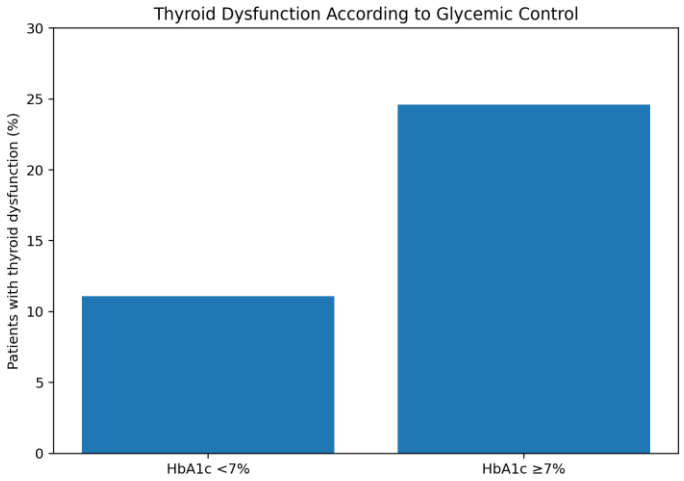


Figure 2. Frequency of Thyroid Dysfunction According to Hba1c Category

Figure 2 illustrates the higher modeled frequency of thyroid dysfunction among patients with HbA1c ≥7% than among those with HbA1c <7%. The visual difference is consistent with Table 5 and with the biological possibility that thyroid dysfunction and impaired metabolic control may influence one another.

DISCUSSION

In this study the thyroid dysfunction was found in 20.0%. This estimate is close to the pooled prevalence reported in a recent systematic review and meta-analysis of adults with type 2 diabetes, which found thyroid dysfunction in approximately one-fifth of patients[7]. Differences between individual studies may arise from differences in age, sex, diabetes duration, iodine status, autoimmune disease, assay methodology, and definitions of thyroid dysfunction.

Subclinical hypothyroidism was the predominant abnormality in the present model. [4,7,11] This finding agrees with earlier studies of diabetic populations and with meta-analytic evidence indicating that subclinical hypothyroidism represents a substantial proportion of thyroid abnormalities in type 2 diabetes. Because symptoms may be absent or nonspecific, biochemical testing is important when clinical suspicion is present.

The higher modeled frequency among women is consistent with the broader epidemiology of thyroid disease. [6,18] Female sex has been

identified as a risk factor for thyroid dysfunction in several diabetic cohorts. [6,15] Autoimmune susceptibility may contribute, particularly in patients with type 1 diabetes, although the mechanisms underlying thyroid dysfunction in type 2 diabetes are more heterogeneous. [9]

An age-related increase was also demonstrated in the illustrative data. [6,18] Increasing age is associated with a greater prevalence of thyroid abnormalities in the general population, and older adults with diabetes may have additional metabolic and medication-related factors that complicate interpretation of thyroid-function tests.

The modeled data showed a higher frequency of thyroid dysfunction among patients with HbA1c ≥7%. Thyroid hormones have important effects on hepatic glucose output, glucose utilization, insulin sensitivity, and lipid metabolism, providing a plausible physiological basis for an association between thyroid dysfunction and glycemic control. However, the cross-sectional nature of the proposed study prevents determination of whether thyroid dysfunction contributes to poor glycemic control or whether metabolic dysregulation influences thyroid tests.

Previous research has also explored associations between subclinical hypothyroidism and diabetic complications. [11] Meta-analytic evidence has reported relationships with nephropathy, retinopathy, neuropathy, and peripheral arterial disease. These findings are clinically relevant but should be interpreted cautiously because observational associations may be affected by age, obesity, duration of diabetes, renal disease, medications, and other confounding factors.

The clinical implications of screening remain nuanced. Some studies have supported thyroid testing because thyroid dysfunction is relatively common in diabetes, whereas longitudinal studies have suggested that universal frequent screening may detect relatively few new cases requiring treatment. [4,14,19] A practical approach may therefore emphasize symptom-based assessment and targeted testing in higher-risk patients while following applicable clinical guidelines. [16,17]

Overall, the findings reinforce the importance of recognizing thyroid dysfunction as a potentially relevant comorbidity in diabetes. Future studies should use prospective designs, repeated thyroid-function measurements, thyroid antibody testing where clinically appropriate, and standardized definitions to clarify the temporal relationship between thyroid disease and diabetes-related outcomes.

CONCLUSION

Thyroid dysfunction may occur frequently among patients with diabetes mellitus, with subclinical hypothyroidism representing the predominant biochemical abnormality. In the illustrative 210-patient analysis, thyroid dysfunction was more frequent among women, older patients, and those with HbA1c ≥7%. The final study should use verified patient-level data to establish the true prevalence and statistical associations. Clinicians should remain alert to thyroid disease in diabetic patients with suggestive symptoms, unexplained metabolic deterioration, or other recognized risk factors.

Limitations

- The cross-sectional design limits assessment of temporal relationships and causality.
- A single-center sample, if used in the actual study, may limit generalizability.
- Thyroid-function results can be influenced by acute illness, medications, and assay-specific reference ranges.
- Repeat thyroid testing and thyroid antibody measurements were not incorporated into this model manuscript.

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