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Article

Thyroid Dysfunction Among Diabetic Patients at the Diabetic Endocrine Hospital, Tripoli, Libya, 2022

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Abstract

Background: Thyroid dysfunction is a common endocrine disorder that frequently coexists with diabetes mellitus (DM) and may negatively affect metabolic control and long-term outcomes. Objective: This study aimed to determine the prevalence and pattern of thyroid dysfunction among diabetic patients and to evaluate its association with sociodemographic and clinical variables. Methods: A cross-sectional study was conducted among 256 diabetic patients attending the Diabetic Endocrine Hospital in Tripoli, Libya, in 2022. Demographic data, clinical characteristics, glycemic status, and thyroid function tests were analyzed. Associations of thyroid dysfunction with gender, age, diabetes type and duration, treatment modality, comorbidities, and family history were assessed. Results: Of the 256 diabetic patients included in the study, 95 (37.1%) had thyroid dysfunction, while 161 (62.9%) were euthyroid. Hypothyroidism was the most prevalent thyroid disorder (35.2%). Thyroid disease developed after the diagnosis of diabetes in 25.8% of affected patients. Thyroid dysfunction was significantly more common among females compared with males ($p < 0.001$) and among patients with type 1 diabetes compared with type 2 diabetes ($p < 0.001$). A longer duration of diabetes (≥11 years) was also significantly associated with thyroid dysfunction ($p = 0.038$). Patients receiving insulin therapy had a higher prevalence of thyroid dysfunction ($p = 0.005$). A positive family history of thyroid disease was strongly associated with thyroid dysfunction ($p < 0.001$). Previous thyroid surgery and radioactive iodine therapy were also significantly associated with thyroid dysfunction. In multivariate logistic regression analysis, female sex, type 1 diabetes, longer diabetes duration, and a positive family history of thyroid disease remained independently associated with thyroid dysfunction. Poor glycemic control (HbA1c ≥ 7%) did not remain independently associated with thyroid dysfunction after adjustment. Conclusion: Thyroid dysfunction is highly prevalent among diabetic patients in Tripoli, particularly among females, those with type 1 diabetes, those with long disease duration, and those with a positive family history. These findings support the need for routine thyroid screening as part of comprehensive diabetes care.

Keywords

Thyroid dysfunction, Diabetes mellitus, Prevalence

Article History

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1. Introduction

Diabetes mellitus (DM) and thyroid dysfunction are among the most prevalent endocrine disorders worldwide and pose a substantial public health burden. Both conditions are associated with increased morbidity, mortality, and healthcare costs. A growing body of clinical and epidemiological evidence demonstrates a strong, complex bidirectional relationship between DM and thyroid disorders (TD), with diabetic patients exhibiting a markedly higher prevalence of thyroid dysfunction–particularly subclinical hypothyroidism and autoimmune thyroiditis–than the general population [1-3].

The prevalence of thyroid dysfunction among individuals with diabetes varies widely by geographic region, genetic susceptibility, iodine intake, environmental exposures, and diagnostic criteria [4]. Primary TD most commonly results from autoimmune destruction of the thyroid gland, postsurgical hypothyroidism, radiation-induced thyroiditis, or drug-related thyroid dysfunction [5,6]. Recent studies have further highlighted that autoimmune hypothyroidism and type 1 diabetes frequently coexist because of shared immunogenetic and inflammatory mechanisms [7].

Several international studies have examined the prevalence of TD among people with diabetes. A cohort study in Italy among children and adolescents with type 1 DM found thyroid dysfunction in approximately 23% of participants, with a significantly higher prevalence among females [8]. Population-based studies from Taiwan and Europe similarly reported an increased risk of thyroid disease in young patients with type 1 diabetes [9,10]. Moreover, studies from Saudi Arabia and other Middle Eastern countries have reported prevalence rates of 20% to 35% among patients with type 2 DM [11-13]. These findings underscore that thyroid dysfunction is a frequent and clinically relevant comorbidity in diabetic populations across diverse ethnic and geographic backgrounds.

Despite increasing global attention, evidence from North African countries remains limited, and data from Libya are particularly scarce. Available Libyan studies suggest a considerable burden of TD among diabetic patients, with reported prevalence approaching 38% in some regions [14]. In addition, a retrospective Libyan study of diabetic ketoacidosis admissions highlighted the high frequency of metabolic instability and emphasized the importance of thyroid function assessment in diabetic populations [15]. However, these studies were constrained by relatively small sample sizes and restricted geographic coverage, underscoring the need for updated, large-scale, and regionally representative investigations.

The biological mechanisms linking diabetes and thyroid dysfunction are multifactorial. Thyroid hormones exert profound effects on glucose homeostasis by modulating pancreatic β-cell function, hepatic gluconeogenesis, intestinal glucose absorption, and peripheral insulin sensitivity. Conversely, chronic hyperglycemia and insulin resistance may alter thyroid hormone synthesis, protein binding, and peripheral conversion of thyroxine (T4) to triiodothyronine (T3), resulting in complex abnormalities in thyroid function tests [16,17]. Furthermore, autoimmune mechanisms play a central role in the coexistence of type 1 diabetes and autoimmune thyroid disease, with cross-reactivity between glutamic acid decarboxylase antibodies and thyroid microsomal antigens contributing to overlapping immunopathogenesis [3,7].

Recent systematic reviews and meta-analyses have further emphasized the global burden of this comorbidity. A contemporary meta-analysis published in 2024 reported that the pooled prevalence of thyroid dysfunction among diabetic patients ranged between 11% and 20%, with hypothyroidism representing the dominant form [18]. Additionally, recent studies published between 2022 and 2024 from the Middle East, Africa, and Asia have demonstrated variable prevalence rates, highlighting the potential influence of genetic, environmental, and lifestyle factors on thyroid disease expression in diabetic populations [19-21].

Beyond primary TD, several endocrine diseases are associated with impaired glucose metabolism due to hormonal excess or deficiency affecting pancreatic β-cell function and insulin sensitivity. Recent evidence indicates that endocrinopathies such as hyperthyroidism, Cushing's syndrome, acromegaly, pheochromocytoma, glucagonoma, and somatostatinoma may significantly worsen glycemic control through complex neuroendocrine and metabolic mechanisms. These conditions influence blood glucose levels, body mass index, and insulin resistance, and necessitate systematic screening for diabetes in patients with endocrine disorders [22].

Furthermore, the COVID-19 pandemic has introduced new challenges to endocrine regulation. Emerging evidence suggests that SARS-CoV-2 infection may induce transient thyroiditis, autoimmune thyroid activation, and disturbances of the hypothalamic-pituitary-thyroid axis. In diabetic patients, this immune dysregulation may further destabilize glycemic control and complicate the diagnosis of TD, reinforcing the clinical importance of integrated endocrine surveillance [23].

In resource-limited healthcare settings such as Libya, improving the understanding of this comorbidity is essential for optimizing clinical care and developing cost-effective screening strategies. Therefore, this study aimed to determine the prevalence of thyroid dysfunction among diabetic patients attending the Diabetic Endocrine Hospital in Tripoli, Libya, and to assess its association with key demographic and clinical characteristics.

2. Materials and Methods

2.1 Study Design and Setting

This was a cross-sectional observational study conducted at the outpatient endocrine clinic of the Diabetic and Endocrine Hospital in Tripoli, Libya, between May and September 2022. A total of 256 diabetic patients aged 18 years or older were consecutively enrolled during the study period.

2.2 Study Population

Inclusion Criteria

Patients were eligible for inclusion if they:

- Had a confirmed diagnosis of type 1 or type 2 DM, either newly diagnosed or longstanding.
- Were receiving oral hypoglycemic agents and/or insulin.
- Had available thyroid function test results and thyroid ultrasound reports.
- Provided verbal consent to participate.

Exclusion Criteria

Patients were excluded if they had:

- Newly diagnosed thyroid dysfunction.
- Gestational DM.
- Acute illness at the time of assessment.
- Cognitive impairment affecting data collection.
- Incomplete medical records.
- Use of medications known to interfere with thyroid function (e.g., amiodarone, systemic corticosteroids).
- Thyroid function tests were performed at the hospital laboratory using a Hitachi automated analyzer according to the manufacturer's instructions and the laboratory reference ranges.
- Definitions of thyroid dysfunction: Thyroid dysfunction was classified based on serum thyroid-stimulating hormone (TSH) and free thyroid hormone levels. Overt hypothyroidism was defined as TSH above the reference range (>4.0 mIU/L) with decreased free thyroxine (FT4) below the reference range, whereas subclinical hypothyroidism was defined as elevated TSH with normal FT4 levels. Overt hyperthyroidism was defined as a suppressed TSH (<0.4 mIU/L) with elevated FT4 and/or free triiodothyronine (FT3), whereas subclinical hyperthyroidism was defined as a suppressed TSH with normal FT4 and FT3 levels, according to the laboratory reference ranges used at the study center.
- Thyroid ultrasound was performed for all enrolled patients as part of the standard diagnostic protocol at the Diabetic Endocrine Hospital to ensure uniform assessment and to minimize the risk of missing structural thyroid abnormalities.

2.3 Data Collection

Data were collected using a structured questionnaire administered through direct patient interviews. The following information was recorded:

- Demographic data: age and gender.
- Diabetes-related variables: type of diabetes, duration of disease, and treatment regimen.
- Clinical data: presence of thyroid enlargement, comorbidities (such as hypertension and dyslipidemia), family history of thyroid disease, history of thyroid surgery, and exposure to radioactive iodine.
- Laboratory data: serum TSH levels and glycated hemoglobin (HbA1c).
- Imaging data: thyroid ultrasound findings obtained from medical records.

2.4 Laboratory Measurements

Thyroid function tests were performed using standardized chemiluminescent immunoassay techniques. Serum levels of TSH, FT4, and FT3 were measured according to the hospital laboratory protocols. The reference ranges used were:

- TSH: 0.4-4.0 mIU/L

- FT4: 0.8-1.8 ng/dL
- FT3: 2.3-4.2 pg/mL

Based on these values, patients were classified as hypothyroid, hyperthyroid, or euthyroid. Internal quality control procedures were routinely applied to ensure the accuracy and reliability of laboratory results.

2.5 Statistical Analysis

Data were analyzed using SPSS software for Windows (version 26.0).

- Categorical variables were expressed as frequencies and percentages.
- Continuous variables were presented as means ± standard deviations.
- Associations between categorical variables were assessed using the chi-square test.

A two-tailed p-value < 0.05 was considered statistically significant.

Multivariate logistic regression was used to identify independent predictors of thyroid dysfunction. Variables that were clinically relevant and/or statistically significant in univariate analysis were entered into the model using the enter method. Thyroid dysfunction (yes/no) served as the dependent variable. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value < 0.05 was considered statistically significant. Statistical analysis was performed using IBM SPSS Statistics version 26.0.

3. Results

A total of 256 diabetic patients were included in the present study. Thyroid dysfunction was identified in 95 patients, yielding an overall prevalence of 37.1%, while 161 patients (62.9%) were euthyroid. Hypothyroidism was the most common thyroid disorder, accounting for 90 cases (35.2%), followed by hyperthyroidism in six patients (2.3%), subclinical hypothyroidism in three patients (1.2%), and subclinical hyperthyroidism in one patient (0.4%) (Figure 1).

All numerical values and percentages were cross-verified with the tables, and the narrative description was adjusted to ensure full consistency.

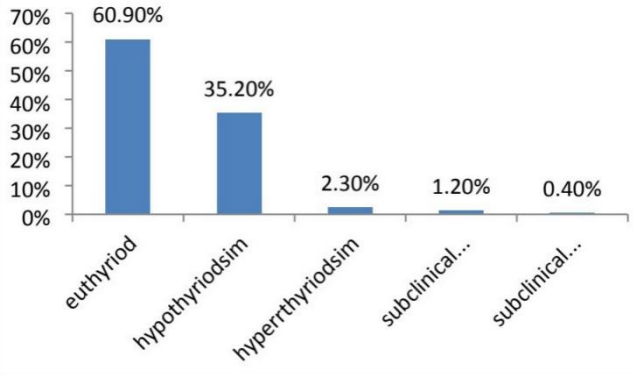

Figure 1. Distribution of thyroid status among the total study population (n = 256).

Regarding the temporal relationship between diabetes and thyroid disease, thyroid dysfunction developed after the diagnosis of diabetes in 66 patients (25.8% of the total study population), whereas thyroid disease was diagnosed before diabetes in 26 patients (10.2%). Concurrent onset of both conditions was observed in four cases (1.6%) (Figure 2).

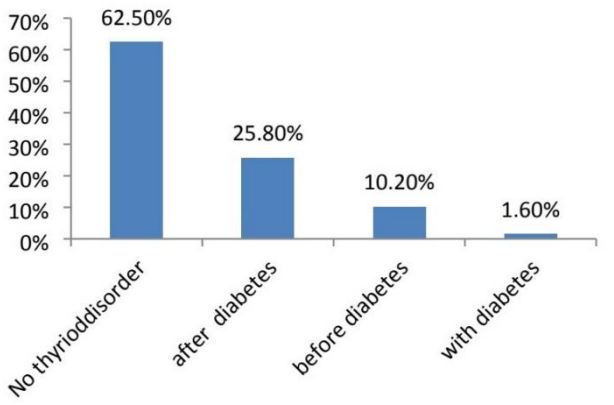

Figure 2. Temporal relationship between diabetes and thyroid dysfunction.

The study population consisted of 91 males (35.5%) and 165 females (64.5%), with a mean age of 51.20 ± 13.59 years. The majority of participants (76.6%) were younger than 60 years. Thyroid dysfunction was significantly more prevalent among females, affecting 47.9% of female participants compared with 6.3% of males ($p < 0.001$). Although the highest proportion of thyroid dysfunction was observed in patients younger than 60 years (28.1%), age was not significantly associated with thyroid dysfunction ($p = 0.364$) (Table 1).

Reference ranges: TSH (0.4-4.0), FT4 (0.8-1.8), FT3 (2.3-4.2).

Table 1. Correlation of TD with gender and age.

Thyroid Disorder	Males (N=91)	Females (N=165)	P value	Age in Years < 50	Age in Years 50-60	Age in Years > 60	P value
present	16(17.6%)	79(47.9%)	< 0.001	30(32.3%)	46(41.8%)	19(35.8%)	0.364
absent	75(82.4%)	86(52.1%)		63(67.7%)	64(58.2%)	34(64.2%)	

Note: Data are presented as a number (percentage within subgroup).

Among patients, 117 (45.7%) had type 1 diabetes and 139 (54.3%) had type 2 diabetes. Thyroid dysfunction was detected in 61.5% of patients with type 1 diabetes and in 16.5% of those with type 2 diabetes ($p < 0.001$). The mean duration of diabetes was 9.79 ± 7.92 years. A significant association was observed between thyroid dysfunction and longer diabetes duration: 16.4% of patients with a disease duration of 11 years or more had TD ($p = 0.038$) (Table 2). Among patients with thyroid dysfunction (n = 95), 72 (75.8%) had type 1 diabetes, and 23 (24.2%) had type 2 diabetes.

Table 2. Correlation of TD with type and duration of diabetes.

Thyroid Disorder	Type I (N=117)	Type II (N=139)	P value	Duration in Years < 1 (N=21)	Duration in Years 1-5 (N=84)	Duration in Years 6-10 (N=54)	Duration in Years ≥11 (N=97)	P value
Present	72(61.5%)	23(16.5%)	< 0.001	2(9.5%)	31(36.9%)	20(37.0%)	42(43.3%)	0.038
Absent	45(38.5%)	116(83.5%)		19(90.5%)	53(63.1%)	34(63.0%)	55(56.7%)	

Note: Data are presented as numbers (percentage within column)

In terms of treatment modality, thyroid dysfunction was significantly more prevalent among patients receiving insulin therapy compared with those treated with oral antidiabetic agents (38.8% vs. 34.4%, $p = 0.005$). No significant association was observed between glycemic control (HbA1c categories) and thyroid dysfunction ($p = 0.715$) (Table 3).

Table3. Correlation of TD with Treatment and states of diabetes.

Thyroid Disorder	Oral (N=96)	Insulin (N=160)	P value	HbA1C < 7 (N=54)	HbA1C ≥ 7 (N=202)	P value
Present	33(34.4%)	62(38.8%)	0.005	21(38.9%)	74(36.6%)	0.715
Absent	63(65.6%)	98(61.2%)		33(61.1%)	128(63.4%)	

Note: Percentages are calculated within each treatment and glycemic control subgroup.

Diabetic complications were observed in a subset of patients, including neuropathy (9%), macrovascular complications (7.4%), retinopathy (7%), and nephropathy (0.8%). However, no statistically significant association was found between thyroid dysfunction and the presence of diabetic complications ($p = 0.097$).

No statistically significant association was observed between HbA1c categories and thyroid dysfunction ($p = 0.715$) (Table 3, Figure 3).

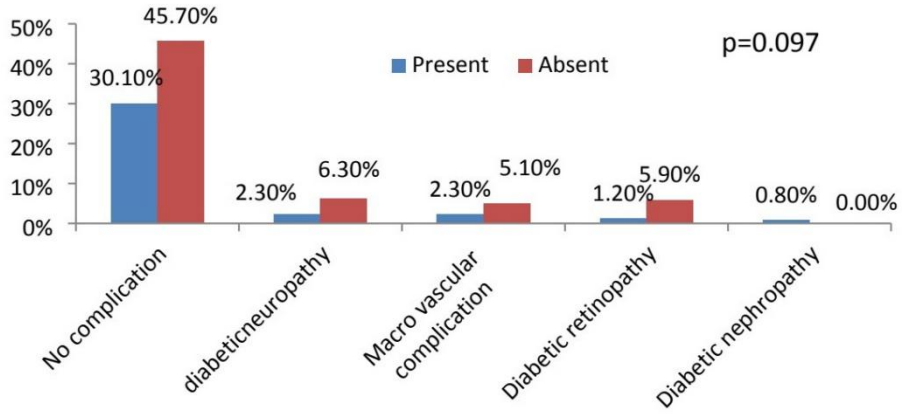

Figure 3. Association between thyroid dysfunction and diabetic complications.

Among the investigated comorbid conditions, hypertension was observed in 93 patients (36.3%), of whom 31 patients (12.1%) had concomitant thyroid dysfunction. However, no statistically significant association was identified between hypertension and TD (p = 0.345). Similarly, hyperlipidemia was documented in 49 patients (18.8%), with thyroid dysfunction present in 14 cases (5.5%), and this association also failed to reach statistical significance (p = 0.206).

Table 4. Correlation of TD with hypertension, hyperlipidemia, and family history of thyroid disease.

Thyroid Disorder	HTN Present (N=93)	HTN Absent (N=163)	P value	Dyslipidemia Present (N=48)	Dyslipidemia Absent (N=208)	P value	FH Present (N=26)	FH Absent (N=168)	P value
Present	31(33.3%)	64(39.3%)	0.345	14(29.2%)	81(38.9%)	0.206	15(57.7%)	20(11.9%)	< 0.001
Absent	62(66.7%)	99(60.7%)		34(70.8%)	127(61.1%)		11(42.3%)	148(88.1%)	

Note: Percentages are calculated within each comorbidity subgroup.

Regarding thyroid-related interventions and comorbidities, no statistically significant associations were observed between thyroid dysfunction and hypertension (p = 0.345), dyslipidemia (p = 0.206), or thyroid swelling detected by ultrasound (p = 0.285). In contrast, a strong and statistically significant association was found between thyroid dysfunction and prior radioactive iodine therapy as well as previous thyroid surgery, with all treated patients exhibiting thyroid dysfunction (p < 0.001). Additionally, a positive family history of thyroid disease was significantly associated with thyroid dysfunction (p < 0.001) (Table 5).

Table 5. Correlation of TD with thyroid swelling, use of radioactive iodine, and surgical intervention of the thyroid.

Thyroid Disorder	Thyroid Swelling Present (N=5)	Thyroid Swelling Absent (N=161)	P value	Radioactive Iodine Therapy (N=13)	Radioactive Iodine Absent (N=243)	P value	Surgical Intervention for Thyroid Present (N=12)	Surgical Intervention for a Thyroid Absent (N=244)	P value
Present	3(60.0%)	92(36.7%)	0.285	13(13.7%)	82(86.3%)	<0.001	12(12.6%)	83(34.0%)	<0.001
Absent	2(40.0%)	159(63.3%)		82 (86.3%)	161(66.3%)		83(87.4%)	161(66.0%)	

Note: Percentages were calculated within each respective subgroup.

Table 6. Multivariate logistic regression analysis of factors associated with thyroid dysfunction among diabetic patients (n = 256).

Variable	β Coefficient	Odds Ratio (OR)	CI 95%	P value
Female sex	1.545	4.69	2.38-9.23	<0.001
Type 1 diabetes	1.618	5.04	2.23-11.38	<0.001
Diabetes duration ≥ 11 years	0.712	2.04	1.23-3.38	<0.001
Positive family history of thyroid disease	2.001	7.40	4.08-13.40	<0.001
Poor glycemic control (HbA1c ≥ 7%)	0.452	1.57	0.89-2.78	0.105

Multivariate logistic regression analysis was conducted, including clinically relevant variables. Thyroid dysfunction (yes/no) served as the dependent variable. Female sex, type 1 diabetes, longer duration of diabetes, and a positive family history of thyroid disease remained independently associated with thyroid dysfunction, while poor glycemic control did not retain statistical significance in the adjusted model (Table 6).

4. Discussion

4.1 Summary of Key Findings

The present study investigated the prevalence and determinants of thyroid dysfunction among diabetic patients attending the Diabetic Endocrine Hospital in Tripoli, Libya. The main findings demonstrate a high overall prevalence of thyroid dysfunction (37.1%) among diabetic patients, with hypothyroidism representing the most frequent abnormality (35.2%). Thyroid dysfunction was significantly more common among females, patients with type 1 diabetes, those with longer diabetes duration, individuals receiving insulin therapy, patients with poor glycemic control, and those with a positive family history of thyroid disease.

These findings highlight a substantial burden of TD among diabetic patients in this population and underscore the importance of systematic screening in routine diabetes care.

4.2 Comparison with Existing Literature

The coexistence of DM and TD is a well-established phenomenon, as both represent two of the most common endocrine diseases encountered in clinical practice [1,2]. This association has been consistently reported across different populations and geographic regions, with several studies demonstrating a close relationship between thyroid dysfunction and diabetes, particularly in type 2 diabetes [24,25].

In the present study, thyroid dysfunction was detected in 37.1% of diabetic patients, which lies at the upper limit of the prevalence range reported in most international studies, where rates generally range between 16% and 37% [15-19,27]. For instance, a recent systematic review and meta-analysis reported a pooled prevalence between 11% and 20%, with hypothyroidism being the dominant form of thyroid dysfunction [15]. Similarly, a North African cross-sectional study published in 2023 reported prevalence rates comparable to those observed in our cohort [16].

The higher prevalence observed in our population may be explained by several factors. The complex interaction between thyroid hormones and glucose metabolism may further explain this relationship [26], including ethnic and genetic background, dietary iodine intake, regional environmental influences, and a relatively high proportion of patients with long-standing diabetes. In addition, the ready availability of thyroid medications and routine endocrine follow-up at our institution may have contributed to improved case detection compared with community-based studies [19,23].

In our cohort, hypothyroidism was the predominant disorder, followed by hyperthyroidism and subclinical forms. This distribution contrasts with reports from South Asia, where subclinical hypothyroidism has frequently been described as the most common abnormality among diabetic patients [17]. These discrepancies further emphasize the influence of regional, nutritional, and genetic determinants on the epidemiology of thyroid disease in diabetic populations.

4.3 Interpretation of Biological Mechanisms

The increased prevalence of thyroid dysfunction among diabetic patients can largely be attributed to the shared autoimmune basis of both conditions. Autoimmune mechanisms play a central role in the pathogenesis of type 1 diabetes and autoimmune thyroid disease, and patients with one autoimmune endocrine disorder are at increased risk of developing additional autoimmune conditions [3,13]. Cross-reactivity between glutamic acid decarboxylase antibodies and thyroid microsomal antigens has been demonstrated, supporting the concept of overlapping immunopathogenesis [3].

The significantly higher prevalence of thyroid dysfunction among females observed in our study is consistent with previous reports demonstrating a clear female predominance [20]. Estrogen-related modulation of immune responses, effects on thyroid follicular cells, and alterations in thyroxine-binding globulin may partly explain this sex-based difference [20].

Furthermore, thyroid dysfunction was significantly more prevalent among patients with type 1 diabetes, which is in line with the concept of autoimmune polyendocrine syndromes, where autoimmune thyroid disease and type 1 diabetes frequently coexist due to shared genetic susceptibility and immunological pathways [3,7].

Longer duration of diabetes was also associated with a higher prevalence of thyroid dysfunction. Chronic hyperglycemia has been shown to impair peripheral conversion of T4 to T3, disrupt hypothalamic-pituitary-thyroid axis regulation, and promote inflammatory and oxidative stress pathways that may contribute to thyroid dysfunction [1].

Poor glycemic control was another important determinant. Elevated HbA1c levels were associated with a higher prevalence of thyroid dysfunction, consistent with previous studies demonstrating that thyroid hormone abnormalities can worsen insulin resistance, alter hepatic glucose production, and interfere with glucose metabolism [18,19,28].

The association between thyroid dysfunction and poor glycemic control observed in the present study is biologically plausible and consistent with recent molecular and clinical evidence demonstrating that hormonal imbalance directly alters insulin secretion, hepatic glucose production, and peripheral insulin sensitivity [18,20,28].

In the present study, multivariate logistic regression analysis identified female sex, type 1 diabetes, longer duration of diabetes, and a positive family history of thyroid disease as independent predictors of thyroid dysfunction. These findings are consistent with previous reports suggesting a shared autoimmune and genetic background underlying the coexistence of diabetes and TD. The persistence of these associations after adjustment for potential confounders further supports a potential link between these conditions, although causal relationships cannot be inferred from this cross-sectional design.

4.4 Interpretation in the Libyan Population

Evidence from North Africa remains limited, and data from Libya are particularly scarce. The high prevalence observed in this study provides important region-specific evidence that thyroid dysfunction represents a major comorbidity among Libyan diabetic patients. The combination of genetic susceptibility, dietary patterns, and delayed diagnosis of

diabetes may contribute to prolonged metabolic stress and autoimmune activation, thereby increasing the burden of thyroid disease in this population.

Given the rising prevalence of diabetes in Libya and the growing burden of non-communicable diseases, the coexistence of thyroid dysfunction further complicates metabolic control and increases the risk of cardiovascular complications, dyslipidemia, and hypertension.

4.5 Study Limitations

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference regarding the temporal relationship between diabetes and thyroid dysfunction. Second, the study was conducted at a single tertiary referral center, which may limit the generalizability of the findings to the broader Libyan population. Third, thyroid autoantibodies were not routinely assessed, which would have allowed a more precise characterization of autoimmune thyroid disease. Finally, information on iodine intake and dietary patterns was not available.

In addition, although thyroid ultrasound was performed systematically in all patients, this approach may have increased the likelihood of detecting structural abnormalities. However, thyroid dysfunction was defined strictly based on biochemical parameters rather than ultrasound findings.

4.6 Clinical Implications and Conclusions

From a clinical and public health perspective, the coexistence of diabetes and thyroid dysfunction represents a major management challenge. Even mild thyroid hormone abnormalities may interfere with glycemic control, worsen dyslipidemia, and increase cardiovascular risk.

Our findings strongly support the incorporation of routine thyroid function screening into standard diabetes care, particularly for high-risk groups such as women, patients with type 1 diabetes, individuals with long-standing disease, those with poor glycemic control, and patients with a family history of thyroid disease. In resource-limited settings such as Libya, early detection and treatment of thyroid dysfunction may represent a cost-effective strategy to improve metabolic outcomes and reduce long-term morbidity.

Future longitudinal studies are needed to further explore the natural history of thyroid dysfunction in diabetic patients and to evaluate the impact of early intervention on glycemic control and cardiovascular outcomes in this population. The findings of this study have important clinical implications. Routine screening for thyroid dysfunction among diabetic patients should be considered an integral part of diabetes management, especially for women, patients with long-standing diabetes, and those with poor glycemic control. Early identification and appropriate treatment of thyroid abnormalities can improve metabolic balance, enhance insulin sensitivity, and reduce the risk of cardiovascular and microvascular complications. Integrating thyroid evaluation into diabetes care protocols may therefore improve overall clinical outcomes and quality of life for affected patients.

The findings of this study emphasize the importance of routine thyroid function screening in patients with type 2 diabetes, particularly those with poor glycemic control. Early identification of thyroid dysfunction may help prevent metabolic complications, improve glycemic regulation, and reduce the long-term risk of cardiovascular disease. Incorporating thyroid function assessment into standard diabetes care protocols in Libya could significantly enhance patient outcomes. Future studies are encouraged to investigate longitudinal outcomes, autoimmune markers, and genetic susceptibility within the Libyan population. These observations are in line with global evidence highlighting the growing burden of diabetes and endocrine disorders worldwide [29] and further support the documented association between thyroid dysfunction and type 2 diabetes.

5. Limitations and Future Directions

This study has some limitations. First, it was conducted in a single center, which may limit the generalizability of the results to the wider Libyan population. Second, the cross-sectional design does not allow us to establish causal relationships between thyroid dysfunction and diabetes outcomes. Third, some confounding factors, such as iodine status, duration of diabetes, and comorbidities, were not fully assessed. Future research should include multicenter studies with larger samples and a longitudinal design to confirm these findings. In addition, molecular and genetic studies are warranted to explore the pathophysiological mechanisms linking thyroid dysfunction and diabetes in North African populations.

6. Conclusion

In conclusion, this study demonstrates a high prevalence of thyroid dysfunction among diabetic patients attending the Diabetic Endocrine Hospital in Tripoli, Libya, with hypothyroidism being the most common form. These findings confirm that TD is a frequent and clinically relevant comorbidity in this population and may substantially contribute to poor glycemic control and increased long-term complications.

The results underscore the clinical need to integrate routine thyroid function screening into standard diabetes care, particularly for high-risk groups, including females, patients with type 1 diabetes, those with long disease duration, and individuals with poor metabolic control. Early identification and appropriate management of thyroid dysfunction may improve metabolic outcomes and reduce cardiovascular and microvascular risks.

Future multicenter, longitudinal studies are warranted to validate these findings, clarify the temporal relationship between diabetes and thyroid dysfunction, and identify genetic, autoimmune, and environmental determinants of this comorbidity among Libyan and North African populations.

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Ethics Statement

Ethical approval for this study was obtained from the senior hospital administration. Verbal informed consent was obtained from all participants before they were included in the study.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request. The data are not publicly available due to institutional privacy restrictions.

Author Contributions

A.E. conceptualized and designed the study. A.E., S.A., and H.E. contributed to data collection and interpretation. A.E. performed the statistical analysis and drafted the manuscript. All authors critically revised the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

Conflict of Interest

The authors declare no conflicts of interest.

Generative AI Statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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