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Prevalence of thyroid disorders in type 2 diabetic patients – A 1-year cross-sectional study

Rikita Ramesh Mudhol[1], Shivakumar Veeranna Turamari[2], Rekha Ramesh Mudhol[3], B. Srinivas[2]

Abstract:

BACKGROUND: Diabetes is one of the commonest health problem and has become a major health challenge worldwide. There is evidence from the literature suggesting that the intricate bond between Thyroid disorder and diabetes mellitus deceivingly contributes to micro and macro-vascular complications.

OBJECTIVE: This study is being undertaken to determine an association between prevalence of thyroid disorders in Type 2 diabetic patients.

MATERIAL AND METHODS: A hospital based prospective cross sectional study was carried out in the department of Medicine, at a tertiary care hospital in Belgaum. The study included 100 Type 2 diabetic patients who were interviewed for demographic details, duration of diabetes and history of other comorbid conditions. The patients were subjected to clinical examination and were investigated for fasting blood sugars, post prandial blood sugars, glycosylated haemoglobin (HbA1C), free triiodothyronine (T3), free thyroxine (T4) and thyroid-stimulating hormone (TSH). Data was analysed using SPSS statistical software version 20.0.

RESULTS: The prevalence of thyroid disorder in type 2 diabetic patients was 35%. Of them 16% had subclinical hypothyroidism. The males outnumbered the females in the study and 22% of the males had thyroid disorder ($P = 0.8390$).Subjects in the age group of 61 to 70 years, prevalence was higher as compared to other groups ($P = 0.0569$).There was an increased risk of thyroid dysfunction in long standing type 2 diabetics ($P = 0.0240$).The prevalence was higher in patients with poor glycemic control, though the findings were not statistically significant ($P = 0.1021$).

CONCLUSION: Thyroid Dysfunction is widely prevalent in patients with type 2 diabetes in our study. Hence it is prudent to screen routinely for Thyroid dysfunction in type 2 Diabetic patients, which will help in improving the quality of life and reduce the mortality rate.

Keywords:

Diabetes mellitus, subclinical hypothyroidism, thyroid disorder

[1]Department of General Medicine, SDM College of Medical Sciences & Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad, [2]Departments of General Medicine, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Belagavi, [3]Professor, MS DOMS PhD Ophthalmology, Shri. B.M.Patil Medical College, Hospital and Research Centre BLDE (Deemed to be University), Vijayapur, Karnataka, India

Address for correspondence:
Dr. Rikita Ramesh Mudhol, Assistant Professor, Department of General Medicine, SDM College of Medical Sciences & Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad - 580009, Karnataka, India.
E-mail: rikita.mudhol@gmail.com

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Diabetes mellitus (DM) is one of the most prevalent endocrine disorders. Absolute or relative deficiency of insulin causes diabetes. The lack of insulin leads to significant water and electrolyte imbalance. The electrolyte imbalance will result in acute metabolic complications and mortality.[1]

DM increases morbidity and mortality by its complications that affect the small vessels causing retinopathy, nephropathy, neuropathy, and large vessels leading to ischemic heart disease and cerebrovascular accidents. These complications also affect the quality of life.[2]

In the past 20 years, the prevalence of DM has increased worldwide, from a projected 30 million cases in 1985 to 415 million in 2017. As there is an increasing trend in DM, 578 million individuals will have diabetes by the year 2030, and 700 million people will

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have DM by the year 2045. Diabetes is a primary cause of mortality, but several studies indicate that diabetes is likely under-reported as a cause of death.[3]

The thyroid hormones thyroxine (T4) and triiodothyronine (T3) help to regulate the thermogenic and metabolic homeostasis in adults.[2]

Thyroid disorders are widely prevalent all over the world among different populations. Many studies have documented that people with type 2 DM have a higher incidence of thyroid dysfunction.[4]

Hypothyroidism and hyperthyroidism are the two thyroid dysfunctions that differ in clinical presentation and pathophysiology functions. Thyroid hormones affect glucose metabolism through several mechanisms in diabetes, which is a matter of investigation. The thyroid hormone directly governs insulin secretion. Thus, glucose-induced insulin secretion is decreased by beta cells in hypothyroidism, whereas in hyperthyroidism, there is glucose tolerance due to an increase in the hepatic glucose output. In DM, retinopathy and neuropathy are significant complications. The complicated bond between DM and subclinical hypothyroidism is deceptively contributing to retinopathy and neuropathy. Thyroid disorders lead to dyslipidemia which in turn causes cardiovascular events and micro or macroangiopathies.[5]

Identifying new cases of thyroid dysfunction and early intervention may significantly reduce the possible aggravation of risk factors such as hypertension and dyslipidemia.[6]

A systematic approach to thyroid function testing in subjects with DM is favorable. Various studies have reported different prevalence rates of the two associated disorders ranging with a vast difference from 12.5% to 13.2%. However, in patients with type 2 DM, there are no definitive guidelines for screening thyroid dysfunction.[7]

The present study aims to know the prevalence of thyroid disorders in type 2 diabetic patients and establish an association between the 2 endocrine disorders.

Materials and Methods

This study is an institutional-based prospective cross-sectional study conducted at a tertiary care hospital in Belagavi for 1 year. The study included 100 patients admitted with type 2 DM with more than 5 years of duration.

Inclusion criteria

All patients admitted with a history of type 2 DM.

Exclusion criteria

- Patients with a known history of thyroid disorders
- Patients with diabetic ketoacidosis and chronic renal failure
- Patients on drugs affecting thyroid profile (cough syrup, lithium, and amiodarone).

The patients underwent an interview to obtain demographic characteristics such as age and sex, presenting complaints, diabetic history, and history of other comorbid conditions. These patients also underwent a clinical examination.

All patients underwent laboratory evaluation to investigate blood sugar levels comprised of fasting blood sugars, postprandial blood sugars, and glycosylated hemoglobin. Furthermore, to rule out diabetes-induced nephropathy, renal function tests such as blood urea and serum creatinine were done. The patients screened for thyroid function tests such as free T3, free T4, and thyroid-stimulating hormone (TSH).

Thyroid dysfunctions were identified using the following definitions.[8] When T3, T4, and TSH were in the normal range, it was considered normal thyroid functions. When TSH is more than 5.5 mIU/ml and T3 and T4 are lesser than usual, it is considered primary hypothyroidism. TSH was more than 5.5 mIU/ml, and T3 and T4 were within the normal range; subclinical hypothyroidism (SCH) was diagnosed. Primary hyperthyroidism is considered when TSH is lower than 0.3 mIU/ml and T3, T4 more than the usual range. When TSH is lesser than 0.3 mIU/ml and T3 and T4 are within normal range, then, it is subclinical hyperthyroidism.

To screen for diabetic retinopathy, all the patients underwent funduscopic examination. The patients are classified as having nonproliferative diabetic retinopathy (NPDR), proliferative diabetic retinopathy, and no evidence of diabetic retinopathy.

The sample size (n) was calculated using the following formula:

$$n = \frac{1.96^2 \times p \times q}{d^2}$$

Where,

n = Sample size

p = Prevalence (32% as obtained from previous study)[9]

q = 100– p (68%)

d = Absolute error (7%)

Therefore,

$P = 32$

$q = 68$

$d = 9$

$$n = \frac{1.96^2 \times 32 \times 68}{9^2}$$

$n = 100$

Ethical permission was obtained from the Institutional Research and Ethical Committee, Ref: Major Diagnostic Categories/Designing out Medical Error/172.

Patients presenting with type 2 DM fulfilling the selection criteria were briefed about the study's nature and included in the study after obtaining written consent.

Statistical methods

The data obtained were entered and analyzed with Statistical Package for the Social Sciences statistical software version 20.0. The categorical data were expressed in terms of rates, ratios, and percentages. The comparison was made using the Chi-square test. The data were expressed as mean ± standard deviation, and an independent *t*-test was used to make comparisons.

Results

In this study, 35% had thyroid disorder of the total 100 type 2 DM patients. Of them, 16% had SCH, 10% had subclinical hyperthyroidism, 6% had primary hyperthyroidism, and 3% had primary hypothyroidism [Table 1].

Out of the total patients studied, most were male (55%) than female (45%) participants. The male-to-female ratio was 3:2. In the 55 male patients, 22 of the males had thyroid disorder, out of which 62.50% of the males had SCH. Out of 45 female patients, 13 of the females had thyroid disorder, in that 37.50% of the females had SCH. However, there was no statistical significance ($P = 0.8390$) [Graph 1].

The patients' ages range from 26 years to 85 years. The mean age was 60.03 with a standard deviation of 11.02. The majority were in the age group of 61–70 years (36%).

Table 1: Distribution of patients with status of thyroid function

Thyroid function	Number of patients (%)
Euthyroid	65 (65.00)
Primary hyperthyroidism	6 (6.00)
Primary hypothyroidism	3 (3.00)
Subclinical hypothyroidism	16 (16.00)
Subclinical hyperthyroidism	10 (10.00)
Total	100 (100.00)

In the age group of 26–50 years, 19 patients were there, of whom three patients had thyroid disorder. Of the 29 patients in the age group of 51–60, 11 patients had thyroid disorder. Out of 36 patients in the age group of 61–70, 15 patients had thyroid disorder. Six out of 16 patients had thyroid disorder in the age group of 71–85 years. However, there was no statistical significance ($P = 0.0569$).

Association between duration of DM and thyroid dysfunction when observed, most of the patients in our study belonged to the group of 11–20 years of duration of diabetes (51%). Out of 35 patients in the 5–10-year duration of diabetes, 5 patients had thyroid disorder. Out of 51 patients in the group of 11–20 years, 24 patients had thyroid disorder. Six out of 14 patients in group 21–30 years of diabetes had thyroid disorder, which was statistically significant ($P = 0.0240$) [Graph 2].

The mean hemoglobin A1c (HbA1c) in euthyroid patients with DM was 8.49. The mean HbA1c in primary hyperthyroid, primary hypothyroid, subclinical hypothyroid, and subclinical hyperthyroid diabetics was 7.90, 7.97, 10.13, and 8.39, respectively. The difference was not statistically significant ($P = 0.1021$).

Out of 100 diabetic patients, 28% of patients were hypertensive. A total of 28 diabetic patients were hypertensive, of which 9 had thyroid disorder. The rest 72 diabetic patients were normotensive, and 26 out of 72 normotensives had thyroid disorder. The difference was not significant ($P = 0.9281$). Of the 100 diabetic patients, 40% had dyslipidemia. Twenty-five patients had thyroid disorder out of 40 dyslipidemic patients, but there was no statistical significance ($P = 0.4825$). The mean body mass index (BMI) in euthyroid diabetics was 23.4. The mean BMI in primary hyperthyroid, primary hypothyroid, subclinical hypothyroid, and subclinical hyperthyroid diabetics was 22.3, 24.6, 23.3, and 23.2, respectively. The difference was statistically not significant ($P = 0.5640$).

In this study, fundoscopy revealed NPDR in 22% of the patients. Out of the 22% patients with NPDR, 16 patients had SCH, and 6 patients were euthyroid. The people with diabetes with primary hyperthyroid, primary hypothyroid, and subclinical hyperthyroid did not have retinopathy. The difference was statistically significant ($P = 0.0340$) [Table 2].

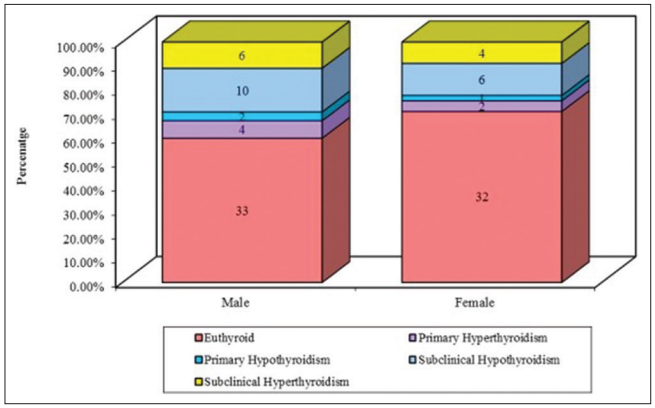
Discussion

Type 2 DM and thyroid disorders are the most common endocrine diseases among the global health challenges faced in a physician's practice. The influence of diabetes and thyroid disorders on each other is almost equal, and the association between the two endocrine conditions has been reported long back in the literature.[4]

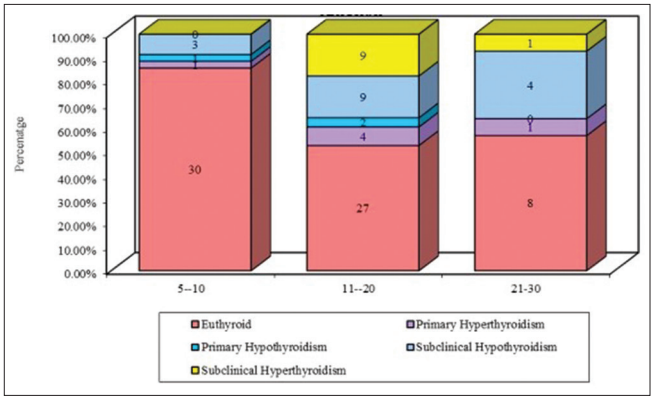
Table 2: Association between fundoscopy and thyroid function

Thyroid function	No retinopathy	Percentage	NPDR	Percentage	PDR	Percentage	Total
Euthyroid	59	90.76	6	9.23	0	0.00	65
Primary hyperthyroidism	6	100	0	0.00	0	0.00	6
Primary hypothyroidism	3	100	0	0.00	0	0.00	3
Subclinical hypothyroidism	0	0.00	16	100	0	0.00	16
Subclinical hyperthyroidism	10	100	0	0.00	0	0.00	10
Total	78	78.00	22	22.00	0	0.00	100

χ^2=16.6458, *P*=0.0340. NPDR=Nonproliferative diabetic retinopathy, PDR=Proliferative diabetic retinopathy



Graph 1: Association between gender and thyroid function



Graph 2: Association between duration of diabetes and thyroid function

In the present study, out of the 100 diabetic patients, 35% of patients had thyroid disorders. The findings of our study are consistent with the findings of Vikhe *et al*.,[8] Demitrost and Ranabir,[7] Díez *et al*.,[9] and Celani *et al*.[10] They reported 30%, 31.2%, 32.4%, and 31.4% prevalence of thyroid disorder in their study, respectively.

The most prevalent thyroid disorder was SCH which occurred in 16% of the study population, followed by subclinical hyperthyroidism in 10%, primary hyperthyroidism in 6%, and primary hypothyroidism in 3% of the total 100 diabetic patients. Thus, among thyroid disorders, the prevalence of SCH was higher. Our results are in concordance with Vikhe *et al*.,[8] in which hypothyroidism was present in 22% and hyperthyroidism is present in 8% of diabetic subjects. Similarly, Demitrost and Ranabir[7] did another study; they observed that 33 (16.3%) had SCH (10 males and 23 females) and 4 (2%) had subclinical hyperthyroidism, whereas 23 (11.4%) had hypothyroidism (17 females and six males), 3 (1.5%) were hyperthyroidism cases, and (68.8%) were euthyroid.

In the present study, males (55%) were more than females (45%), with the male-to-female ratio being 3:2. The above findings suggest a higher prevalence of diabetes in males; there is a similar observation in previous literature.[11-15]

In this study, out of 55 male patients, 22 of the males had a thyroid disorder. In that, 62.50% of the males had SCH. Out of 45 female patients, 13 of the females had a thyroid disorder, in that 37.50% of the females had SCH. There was no statistical significance. In our study, male preponderance was more. However, Yang *et al*.[16] studied 371 people with diabetes, in which 83 subjects (22.4%) are diagnosed with SCH, of whom 29.9% were females, and 12.1% were males.[17] In studies done by Celani *et al*.,[10] Babu *et al*.[18] found that in females with type 2 DM, thyroid disorders are more common.

In this study, majority of the patients were in the age group of 61–70 years (36%), and the mean age was 60.03 years with a standard deviation of 11.02. In the study of Al-Geffari *et al*.,[19] the mean age was 59.0 ± 10.8 years which is similar to the present study.

Out of 35 diabetic patients who had thyroid disorders, 5 had a duration of diabetes between 5 and 10 years, 24 had a duration of diabetes between 11 and 20 years, and 6 had a duration of diabetes between 21 and 30 years. This difference, when evaluated statistically, was significant (P = 0.024). Thus, we found that the duration of diabetes significantly affected the prevalence of thyroid disorder in our study. This association of the duration of diabetes and thyroid disorder did not correlate with other studies.

The mean HbA1C was higher in patients with thyroid disorder as compared to euthyroid patients. The difference was not statistically significant (P = 0.1021).

Thus, we found that the prevalence of thyroid disorder is not affected by the level of HBA1C. Our study finding is similar to the study done by Díez *et al*.[9] However, the study done by Kim *et al*., who retrospectively evaluated people with type 2 diabetes with SCH, concluded that patients with SCH had poor glycemic control.[20,21]

In this study, 9% of the hypertensive patients had thyroid disorder, and 26% of normotensives had a thyroid disorder. However, the difference was not significant ($P = 0.9281$). Thus, the prevalence of thyroid disorder is not affected by hypertension in our study, which is similar to the study done by Kim *et al*., where though the mean systolic blood pressure and diastolic blood pressure were higher in patients with thyroid dysfunction, it was not statistically significant.[20]

In the present study, among the dyslipidemic patients, 25% had thyroid disorder compared to 10% of patients without dyslipidemia. Even though there was dyslipidemia among the patients with thyroid disorder, the findings were not significant statistically ($P = 0.4825$). The results of our study are similar to the study done by Chubb *et al*. and Kim *et al*.[20,22] The association between dyslipidemia and thyroid dysfunction was significant with each lipid parameter except low-density lipoprotein (LDL), which failed to reach significance, was concluded by the study done by Chubb *et al*.[22] In a study by Kim *et al*.,[20] subclinical hypothyroid patients had higher mean values of serum LDL, high-density lipoprotein, total cholesterol, and lower mean triglycerides than euthyroid counterparts. In the parameters recorded, there was no statistical significance between the two groups.

In the present study, the mean BMI in euthyroid diabetics was 23.4 kg/m^2. The mean BMI in primary hyperthyroid, primary hypothyroid, subclinical hypothyroid, and subclinical hyperthyroid diabetics was 22.3, 24.6, 23.3, and 23.2 kg/m^2. The difference was statistically not significant ($P = 0.5640$). The prevalence of thyroid disorder was not affected by BMI in our study. Our findings were comparatively similar to the study done by Proces *et al*.[23]

In our study, 22% of the study population had NPDR. Out of 22 patients with retinopathy, 16 patients had SCH ($P < 0.001$). There was a significant difference in the prevalence of thyroid disorder in people with diabetes with and without retinopathy. Thus, the patients with diabetes also having thyroid disorder could develop sight-threatening diabetic retinopathy. The findings of our study which are similar to a study done by Yang *et al*. found that the prevalence of NPDR was significantly higher in the subclinical hypothyroid patients than the euthyroid patients ($P = 0.000$) after comparing two groups.[17] Another study by Manjunath *et al*. found that 6 SCH patients, i.e. 46% of SCH patients, had NPDR.[24] A meta-analysis by Wu *et al*. found an association between diabetic retinopathy and SCH after analysis of eight studies. It demonstrated that diabetic patients suffering from SCH could increase the risk of diabetic retinopathy.[25]

This study reveals a strong association between thyroid disorder and type 2 DM. Hence, in type 2 DM patients, routine surveillance for thyroid disorder will prove beneficial.

Conclusion

The study's findings showed a significant prevalence of thyroid disorder (35%) in type 2 DM patients, of which the most prevalent was SCH. The prevalence of thyroid disorder was more in males and patients with a longer duration of DM in our study. A higher number of patients had NPDR with SCH. The study population had apparent thyroid dysfunction. Thus, early detection of thyroid disorder will help reduce the morbidity rate and in turn, improve the quality of life of the patients. Hence, it is prudent to screen routinely for thyroid panel in type 2 diabetic patients.

Limitation

The limitation of this study would be the limited population, and the results in a vast population are unpredictable.

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Conflicts of interest

There are no conflicts of interest.

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