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# Study of Thyroid Disorder in Type 2 Diabetes Mellitus

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**Surbhi Thakur**
Post Graduate, Department of Medicine, Santosh Deemed to be University
**Jai Krishna Mishra**
Senoir Resident, DM Cardiology, Shri B.M. Patil Medical College Hospital, Vijayapura, Karnataka
**Shivani Bansal**
Professor, Department of Medicine, Santosh Deemed to be University
**Ranjum Chaudhary**
Assistant Professor, Department of Medicine, Santosh Deemed to be University
**Corresponding Author: Dr. Shivani Bansal**

## Keywords
T2DM, Hypothyroidism, fasting blood sugar, HBA1C.

## Abstract
AIM: To study the prevalence of thyroid disorders in type2 diabetes mellitus.OBJECTIVES: 1. To classify types of thyroid dysfunction in type2 diabetes mellitus. 2. Evaluation of whether thyroid function tests were included in the investigational protocol of type 2 diabetes mellitus. 3. To assess the correlation between HbA1c and serum TSH. Materials and methods: 500 patients with type-2 diabetes, regardless of age or gender, were included in this cross-sectional study. Included were patients who had diabetes mellitus and solely primary thyroid impairment. Every participant followed a diabetic diet and received either insulin, oral anti-diabetic medications, or both. The blood sugars were tested by glucose uptake oxidase peroxidase, the chemiluminescence method used the thyroid function test (T3, T4, TSH), and Glycosylated hemoglobin was calculated by ion exchange high-performance liquid chromatography (HPLC). Results: In our study, patients with type 2 diabetes were much more likely to have thyroid impairment (34%). In the study group, there was a definite female preponderance; the prevalence was 64% among all diabetic patients. Between 50-59 years of age, most patients with diabetes come this age. 19.2% of the total study group patients were hypothyroidism which is the maximum, followed by 11.6% subclinical hypothyroidism. There is a female preponderance (22.8% of the total study group) among diabetic patients having thyroid disorders. Glycosylated hemoglobin and types of thyroid disorders are associated (p-value< .001).Conclusion:Current study shows a clear-cut female preponderance, with a 34% prevalence of overall thyroid disorder.

## 1. Introduction

Diabetes mellitus has an increased susceptibility in the Indian population. Multiple surveys show the propensity of diabetes mellitus among migrant Indians residing in the UK, Singapore, the USA, and South Africa. The local population residing there shows a decreased rate of diabetes than migrants from India [1]. According to WHO, India had 69.2 million people living with diabetes in 2015. The projected figure for 2025 is 80 million, and for 2035 is 108 million, respectively [2]. The estimated number of global diabetes cases was 406 million in 2018, which is expected to increase to "511 million by 2030". "Over half of them will be living in just three countries china (130 million), India (98 million), and the US (32 million)" [2]. It means that during the most productive period of their lives, most patients with diabetes acquire the disease in developing countries. The global diabetic population in the Southeast Asian region

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is estimated to be 20%, likely to triple by 2025, increasing from 60 million to 90 million.

The "most common endocrine diseases" in India are "Thyroid disorders" [3]. Despite the coverage of the "National Iodine Deficiency control program (NIDDCP)" in India, "iodine deficiency" is still prevalent in many parts of India [4]. In females, thyroid dysfunction is more common than in men. In the reproductive age group, 2-4% Prevalence of hypothyroidism is seen and is the cause of infertility and habitual abortion. "Subclinical hypothyroidism is as high as 9.4%; in women, the prevalence is even higher, at 11.4%, compared with men, whose prevalence is 6.2%. People aged 46-54 year shows the highest prevalence of hypothyroidism i.e., 13.1%, with people aged 18-35 years being less affected (7.5 %). The prevalence of hypothyroidism in India is 11%, compared with only 2% in the UK and 4.6% in the USA" [5].

"In 1979, the association between diabetes and thyroid dysfunctions was first published [6,7]. Since 1979 to estimate the prevalence of thyroid dysfunction in patients having diabetes lot of studies have been tried in different countries [8]. A prevalence of 2.2% to 17% has been reported in diabetes with thyroid dysfunction. In addition, the frequency of thyroid disorders is more common in diabetic women than in men. Subclinical hypothyroidism has been shown to affect nearly one in 20 women with type 2 diabetes mellitus" [9]. Abnormal thyroid hormone levels are found in diabetes mellitus[10]. Metabolism of carbohydrates, proteins, and lipids is influenced by insulin and iodothyronine, absence of hormones inhibits diabetes development while higher levels are diabetogenic. Excess or deficiency of Insulin and thyroid hormones results in function derangement [11]. Dyslipidaemia found in type2 diabetes is exacerbated by Subclinical hypothyroidism and reversed by adequate thyroxin replacement, thus lowering the cardiovascular disease risk [12]. Published data on thyroid disease in diabetes have come from inpatients, outpatients, or general practice, and there are limited longitudinal data. However, Indian studies on thyroid disorders are inadequate in type 2 diabetic patients; further such studies among the diabetic population are not there in this part of the country; hence, we did this study.

## 2. Materials and Methods

The study was conducted in "the Department of Medicine, Santosh Medical College, and hospital, Ghaziabad, on patients who attended the Medicine OPD of Santosh Hospital Ghaziabad".

The study will include "500 patients with type-2 diabetes mellitus irrespective of age and both gender randomly presenting to the Santosh hospital".

The diagnosis of T2DM was based on the following criteria.All subjects were on a diabetic diet; oral anti-diabetic agents, insulin, or combined.

**INCLUSION CRITERIA**

a) Blood sugar Fasting: =/> 126mg/dl
b) Blood sugar Postprandial: =/> 140mg/dl
c) Blood sugar Random: =/> 200 mg /dl
d) HbA1c=/>6.5%

"Patients with only primary thyroid dysfunction with diabetes mellitus have been included".

**EXCLUSION CRITERIA**

"a. Disorders of another exocrine and endocrine gland.

b. Pregnancy-induced diabetes mellitus

c. Stress-induced diabetes mellitus

d. Steroid-induced diabetes mellitus

e. Secondary thyroid disease

f. Age < 40 years"

"According to the standard level set-up at Santosh Hospital, Ghaziabad, thyroid profiles were done".

- TSH: 0.3 – 5.5mcgIU/ml
- T3: 60 – 200ng/dl
- T4: 4.5 – 12mcg/dl

"For hyperthyroid patients TSH, T3 and T4 are < 0.3mcgIU/ml, >200ng/dl and >12mcg/dl respectively".

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"For hypothyroid Patients TSH, T3 and T4 levels are > 5.5 mcg IU/ml, <60 ng /dl and < 4.5mcg/dl respectively"

For "subclinical hypothyroid Patients with TSH > 5.1mcgIU/ml with standard T3 and T4 levels"

Ethical approval was obtained from the Institute's ethics committee, and informed consent was obtained from each participant before enrollment in the study. A detailed clinical evaluation of each case was done for the evidence of thyroid disorder. Blood glucose was determined by the glucose uptake oxidase-peroxidase method, the chemiluminescence method was used for thyroid function testing (T3, T4, TSH), and glycosylated hemoglobin was calculated by ion-exchange "high-performance liquid chromatography (HPLC)".

**STATISTICAL ANALYSIS:** "All data were entered into an excel sheet, and available SPSS 19 software was used for statistical analysis". Continuous variables (quantitative data) were represented as mean ± SD. Categorical variables (qualitative data) will be represented as proportion and percentage. "Multiple Linear regression analysis" will be used to avoid the effect of the confounding factors and for a more precise estimate of confounding factors. The Chi-square test ($\chi^2$) was applied where ever applicable. The "p values less than 0.05" will be considered significant. The data acquired was compiled systematically. "Statistical Package of Social Science (SPSS version 19; Chicago Inc., USA) was used for the analysis". The statistical significance of the comparisons was determined by applying specific tests. "Quantitative variables were differentiated using mean values and qualitative variables using proportions". The significance level was calculated at "$P \leq 0.05$".

## 3. Results and Observations

At Santosh hospital Ghaziabad, we conducted a study among Type2 diabetic patients to find out thyroid disorder prevalence. The study was conducted on 500 randomly selected patients with type-2 diabetes mellitus of age=/> 40 yrs. Out of 500 patients, 180 were males, and 320 were females. Moreover, both sex is attending the Santosh hospital as outpatients. Age-wise distribution of Type 2 diabetic patients between 40-49 years there were 97 patients, between 50-59 years there were 173 patients, between 60-69 years, there were 146 patients, between 70-79 years, there were 55 patients, and between 80-89 years there were 29 patients.

All the Type2 diabetic patients fulfilling the criteria have been included; among them, 170 thyroid disorder patients show different clinical manifestations. The type2 of diabetic patients with hypothyroidism was 96, subclinical hypothyroidism was 58, and hyperthyroidism was 16.

## 4. Discussion

In this study, we randomly Selected 500 patients who attended our hospital as outpatients with type 2 diabetes. They represented different backgrounds of the Indian population.

Among the selected patients with altered thyroid disorder are 170, having an incidence of 33.8%. In Smithson's study of diabetics in the United Kingdom, the prevalence of undiagnosed thyroid disease was 5.8%, and among all diabetics, the prevalence was 10.8%. **MaazOzair et al.** 2018 [13] study on North Indian diabetics with a high prevalence of 28% thyroid dysfunction diabetics. **Surrender et al**. [14] 2019 studied on Indian population with a high prevalence of 35.8% thyroid dysfunction in diabetics. 34% prevalence of thyroid dysfunction is seen in the present study, with hypothyroidism being the highest at 19.2%, followed by subclinical hypothyroidism at 11.6% and least hyperthyroidism at 3.2%. Surendra Kumar's study showed a 35.8% prevalence of thyroid disorder in people with diabetes with 61.9% hypothyroidism, followed by sub-clinical hypothyroidism of 27.3%. Thus, we conclude that screening of thyroid profile among type2 diabetes mellitus patients is cost-effective. Our study results were higher than the Smithson and Ridgway studies but equivalent to MaazOzair and Surendra Kumar's study. Hypothyroidism was our study's most common thyroid dysfunction in type2 diabetes mellitus. It accounted for a prevalence of 19% among diabetics.

In comparison, Ridgway et al. showed the

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prevalence of 9.5% hypothyroid in American diabetics. Since the results are significantly high, it warrants screening all type-2 diabetes mellitus patients, especially for hypothyroidism. Our study also showed a prevalence of hyperthyroidism in 3.2% of type2 diabetes mellitus patients compared to the Ridgway study which showed a 2.2% prevalence of hyperthyroidism. In our study, 95 patients with type2 diabetes mellitus had hypothyroidism. The sex distribution revealed that patients who were female were overrepresented. In our study, the majority was 14.4%, whereas in the Smithson study, it was 9.5%. According to a screening programme by J.J. Diez et al., the prevalence of hypothyroidism is highest (15.1%), followed by sub-clinical hypothyroidism (10.7%), and the lowest incidence is hyperthyroidism (3.5%). In addition, we discovered a higher prevalence in individuals referred to a hospital's diabetes clinic than did previous researchers (Perros et al.1995; Chen et al.2007; Ishay et al.2009). The prevalence of subclinical hypothyroidism, which is roughly the same as ours, was determined to be 9% by Ishay et al. (2009).

Our investigation revealed that 11% of males and 22.8% of females had thyroid problems, compared to the extensive study by Perros et al. (1995) [15] that revealed 6.9% of males and 10.9% of females with type 2 diabetes mellitus had thyroid dysfunction. Perros et al. discovered a prevalence of hypothyroidism of 5.8% in male patients and 8.9% in female patients; in our study, there were more female patients, which may be why we identified a lower incidence of 4.6% in male patients. In our study, 1.8% of males and 2% of females had hyperthyroidism, according to Perros et al. The frequency was 1.4% in girls and 1.8% in males.

## 5. Conclusion

The current study shows a clear-cut female preponderance, with a 34% prevalence of overall thyroid disorder. Screening of thyroid disorder in patients with type2 diabetes is recommended based on findings in the present study; it further requires more shreds of evidence which other more extensive studies can achieve.

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**List of tables and figures:**

**Table -1.** Summary distribution of variables, group-wise.

| **Variable** | **Subclinical Hypothyroidism** | **Hypothyroidism** | **Hyperthyroidism** | **P- Value** |
|---|---|---|---|---|
| AGE(years) | 55.84 ± 9.97 | 59.23 ± 8.33 | 60.63±8.14 | 0.001 |
| Duration of Diabetes | 6.67 ± 6.27 | 7.90 ± 5.34 | 8.69 ± 4.51 | 0.001 |
| SBP(mmHg) | 75.97 ± 5.38 | 78.11 ± 6.08 | 80.75 ± 6.40 | 0.001 |
| DBP(mmHg) | 117.86 ± 13.51 | 25.75 ± 13.53 | 135.62 ± 14.68 | 0.001 |
| FBS(mg%) | 130.64 ± 27.10 | 167.98± 33.62 | 112.94± 20.18 | 0.001 |
| PPBS(mg%) | 251.76 ± 37.89 | 277.48 ± 43.09 | 236.31 ± 36.22 | 0.001 |
| HbA1c (%) | 7.68 ± 0.77 | 7.96 ± 0.74 | 7.88 ± 0.87 | 0.001 |
| TSH (mc IU/ml) | 6.94 ± 0.59 | 11.33± 1.94 | 0.016± 0.029 | 0.001 |
| T3(ng/dl) | 111.72 ±19.88 | 109.26 ± 18.66 | 124.30 ±37.73 | 0.188 |
| T4(mcg/dl) | 7.01 ±1.29 | 6.71 ±1.33 | 7.64 ± 2.51 | 0.17 |

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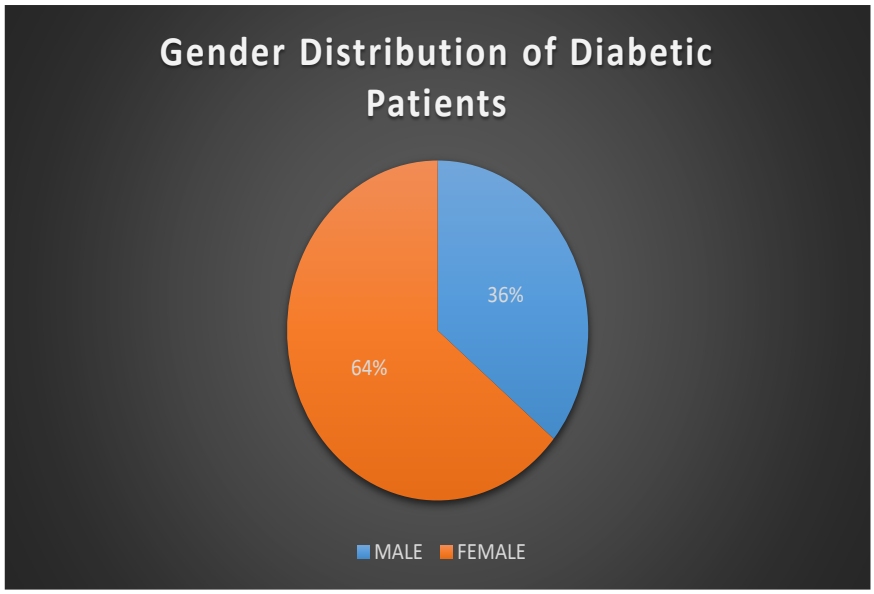
**Graph-1.** Gender distribution of diabetic patients




**Graph 2** Age–Wise distribution of Type-2 diabetic patient

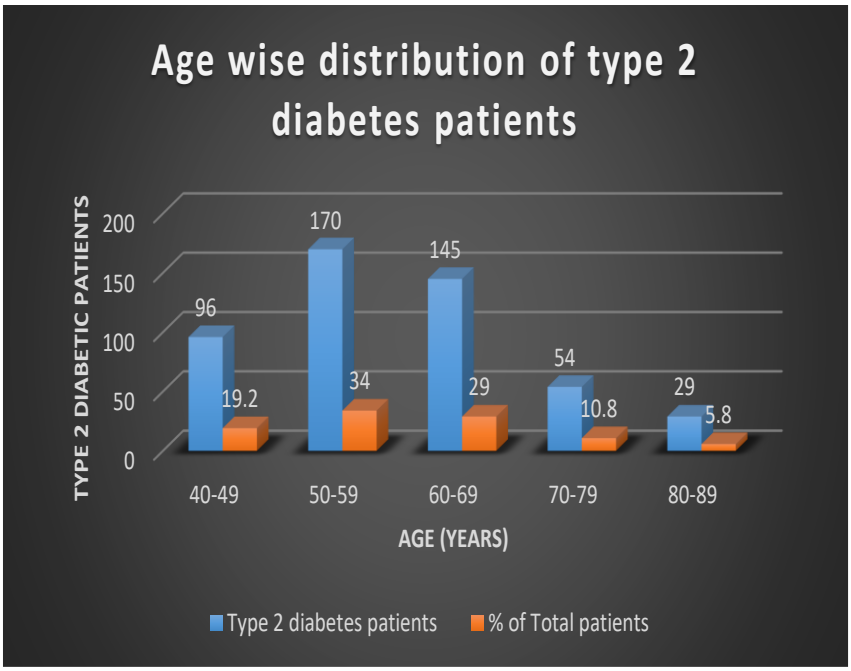



**Table-2.** Gender Distribution OF all Thyroid Disorders in Diabetic Patients

| Gender | Number of Diabetic patients having a thyroid disorder | % of Total Patients |
|---|---|---|
| Female | 114 | 22.8 |
| Male | 56 | 11.2 |
| Total | 170 | 34 |

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**Graph-3.**Gender distribution of different types of thyroid disorders in type 2 DM patients

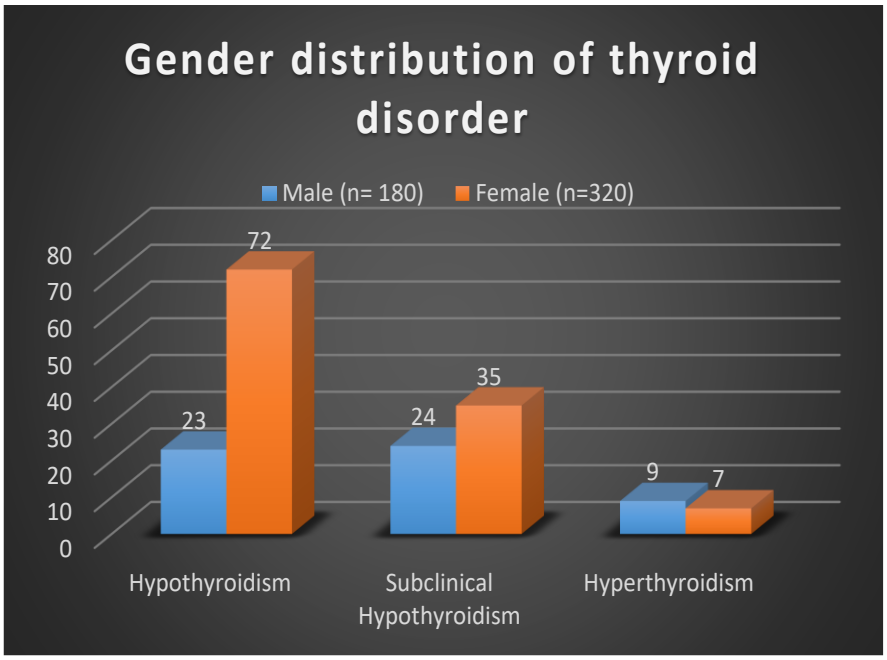


**Table-3.**Age-wise distribution of thyroid disorders in type2 diabetic patients

| Age in years | Subclinical Hypothyroid | Hypothyroidism | Hyperthyroidism |
|---|---|---|---|
| 40-49 | 26 | 11 | 1 |
| 50-59 | 10 | 38 | 6 |
| 60-69 | 14 | 32 | 6 |
| 70-79 | 8 | 14 | 3 |
| 80-89 | 0 | 1 | 0 |
| Total | 58 | 96 | 16 |

**Table-4.** summarizing statistics of the age-wise distribution of thyroid disorders

| Variable | Subclinical Hypothyroidism | Hypothyroidism | Hyperthyroidism | P- value |
|---|---|---|---|---|
| AGE(years) | 55.84 ±9.97 | 59.23 ± 8.33 | 60.63±8.14 | 0.001 |

Age and type of thyroid disorders are associated (p-value<.001). Further, to detect the kind of association/correlation, ANOVA has been performed, which is highly significant (p-value<.001); hence we can conclude that various types of the thyroid have significantly different ages.

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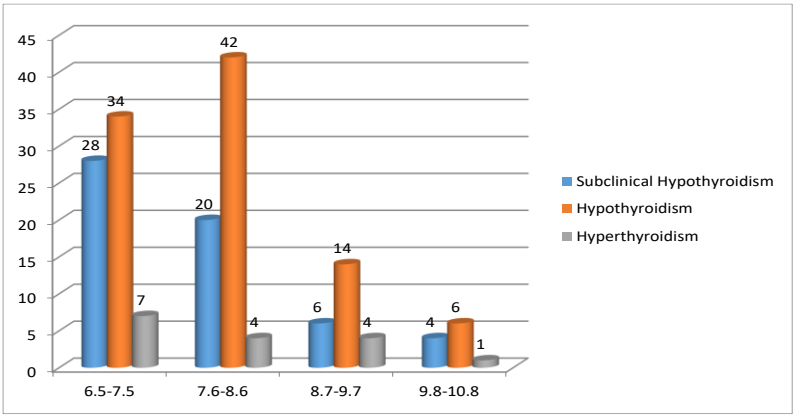
**Table-5.** Summarizing statistics of types of thyroid disorders with the duration of diabetes

| Variable | Subclinical Hypothyroidism | Hypothyroidism | Hyperthyroidism | P- value |
|---|---|---|---|---|
| Duration of Diabetes | 6.67 ± 6.27 | 7.90 ± 5.34 | 8.69± 4.51 | 0.001 |

**Graph-4.** HbA1c levels concerning the type of thyroid disorders




HbA1c (%)

**Table-6.** summarizing the correlation between HbA1c and TSH

The correlation between HbA1c and TSH is .345, which is a weak positive correlation. The correlation between the two variables is significant, with a P value of .001. The graph shows that as the TSH value increases, HbA1c also increases but with a weak positive correlation.

| Group1 | Group2 | Correlation (r) | P- value |
|---|---|---|---|
| HbA1c | TSH | 0.345 | 0.001 |

**Graph 7** shows the correlation between HbA1c and TSH.