Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v31i3.4800

PREVALENCE OF THYROID DYSFUNCTION AMONG TYPE 2 DIABETES MELLITUS IN URBAN AREAS OF BELAGAVI, KARNATAKA, INDIA

Jambulingam Vasanthakumar[1*], Babu Suwethaa[2]

[1*]Department of Community Medicine, Sri Venkateshwara Medical College Hospital & Research Centre, Puducherry, India. Email: vasu.snare@gmail.com
[2]Department of Biochemistry, Vinayaka Mission's Medical College & Hospital, Vinayaka Mission's Research Foundation (DU), Karaikal, Puducherry, India.
Email: swetha.ami16@gmail.com

***Corresponding Author:** Jambulingam Vasanthakumar
*Department of Community Medicine, Sri Venkateshwara Medical College Hospital & Research Centre, Puducherry, India E-mail: vasu.snare@gmail.com

Abstract

Introduction: Diabetes is a major disease burden in India and we are home to the second largest number of diabetes cases in the world with currently over 74.2 million cases of diabetes. Type 2 diabetes mellitus and thyroid disorders are highly prevalent disorders in the community. Both have been shown to mutually influence each other. Recognition of this interdependent relationship between thyroid disease and diabetes is of significance in guiding clinicians towards optimal management of both these conditions.

Objective: To determine the prevalence of thyroid dysfunction among type 2 diabetes mellitus patients and the risk factors associated with it.

Methodology: Data was collected from type 2 diabetes mellitus patients residing in areas under the Urban Health Centre Ashok Nagar and Rukmini Nagar, Belagavi. Study participants were selected based on the selection criteria. Information about socio-demographic profile, risk behaviors, general physical examination, systemic and thyroid examination were collected. Venous blood samples were collected to estimate thyroid profile (T3, T4, TSH), FBS and PPBS.

Results: The prevalence of thyroid disorders was 21.58%. Sub-clinical hypothyroidism was more common than other conditions which constituted 13.68% of the thyroid dysfunction in the type 2 diabetes mellitus patients. Statistically significant association was observed with factors such as gender, physical activity during leisure time, waist hip ratio and glycemic status with p value less than 0.05. Multivariate analysis demonstrated the presence of thyroid disorder was related with glycemic status of the participants with odds ratio 1.85 (CI, 0.996 – 3.443).

Conclusion: This study shows that a significant proportion of type 2 diabetes patients suffer from thyroid dysfunction and screening for the same should be routinely considered, as it is found to be an additional co-morbidity.

Key words: Type 2 Diabetes mellitus, Thyroid dysfunction, Prevalence, Hypothyroidism

INTRODUCTION

Diabetes is a major disease burden in India and we are home to the second largest number of diabetes cases in the world. In 2021, there were over 74.2 million cases of diabetes in India.[1] The reported global prevalence of thyroid disorders in general population varies from 6.6% to 13.4%, whereas in diabetic population, the prevalence is still higher, ranging from 10% to 24%.[2] Thyroid dysfunction manifests either as hypothyroidism or hyperthyroidism which is estimated by the circulating levels of TSH and might affect glucose homeostasis[3].

Diabetes mellitus and thyroid dysfunctions are metabolic disorders that affect the carbohydrates, proteins and lipids metabolism.[4] Thyroid hormones are insulin antagonists, both insulin and thyroid hormones are involved in cellular metabolism and excess and deficit of any can result in functional derangement of the other.[5] Thyroid hormones influence glucose metabolism by the stimulation of glucose absorption, glycogenolysis and hepatic glucose production as well as enhanced insulin resistance. Insulin resistance in hyperthyroidism is strongly associated with enhanced hepatic gluconeogenesis. Hypothyroidism decreases hepatic glucose output by decreasing the absorption of glucose which reduces insulin synthesis which explains the decrease in peripheral glucose utilisation and insulin resistance. Conversely, poorly controlled diabetes mellitus may affect thyroid metabolism as uncontrolled hyperglycemia alters plasma triiodothyronine (T3) and in part thyroxine (T4) levels.[6][7]

Considering the strong association, American Diabetes Association (ADA) had proposed that people with diabetes must be checked periodically for thyroid dysfunction. Thyroid disease should be screened annually in diabetic patients to detect subclinical thyroid dysfunction.[8]

Recognition of this interdependent relationship between thyroid disease and diabetes is of significance in guiding clinicians towards optimal management of both these conditions. Although many such studies have been conducted, to the best of our knowledge no community-based studies have been organised to estimate prevalence of thyroid dysfunctions in patients with type 2 diabetes mellitus (T2DM) in this part of Karnataka.

Hence this study has been planned to know the magnitude of thyroid dysfunction in diabetes population and its associated risk factors.

OBJECTIVES

1. To estimate the prevalence of thyroid dysfunction among type 2 diabetes mellitus patients in urban areas of Belagavi
2. To determine the risk factors associated with thyroid dysfunction among them

MATERIALS AND METHODOLOGY

Study population: Type 2 diabetes mellitus patients residing in areas belonging to Ashok Nagar Urban Health Centre [UHC] and Rukmini Nagar Urban Health Centre in Belagavi, Karnataka.

Study design: A cross sectional study

Study period: January 2019 to December 2019

Sample size: Sample size was calculated as 380 assuming that the prevalence of thyroid dysfunction among type 2 diabetes mellitus patients is 37%[6] and that the true prevalence is expected to fall within ±5% with a confidence level of 95%, using the formula n = 4pq / d2

Sampling method: Simple random sampling

METHOD OF COLLECTION OF DATA:

Selection criteria:

Inclusion criteria:

1. Type 2 diabetes mellitus patients residing in the study area.

Exclusion criteria:

1. Type 1 diabetes mellitus
2. Patient on drugs affecting the thyroid status (ex: Amiodarone, Lithium, anti-thyroid drugs, thyroxine)
3. Patients with previous history of thyroid surgeries (Total/subtotal thyroidectomy)
4. Patients on radioactive iodine treatment
5. Patients with history of Grave's disease and thyroid malignancies
6. Patients with known case of thyroid dysfunction diagnosed prior to type 2 diabetes mellitus
7. Pregnant and lactating women
8. Drug induced diabetes (ex: Steroids, Anti-depressants – Amitriptyline, Tacrolimus)

Ethical Clearance:

The study was approved from Institutional Ethics Committee for Human Subject's Research, Jawaharlal Nehru Medical College, K.L.E University; Belagavi.

Data Collection:

Periodic non communicable disease camps were conducted within the study areas to identify the known case of type 2 diabetes mellitus patients (T2DM). From the identified T2DM patients, study participants were selected based on the selection criteria. The selected patients were given appointment for reporting at the nearest Urban Health Centre which was convenient to the participants. Since fasting samples were to be collected, the participants were advised in writing about the instructions regarding overnight fasting and the time in early morning to assemble at the centres. Data was collected using a pre designed and pre tested questionnaire by personal interview method from the participants. General physical examination and systemic examination was done. A total of 5 ml of venous blood from antecubital vein was collected after overnight fasting for estimation of fasting plasma glucose and thyroid hormone estimation (T3, T4, and TSH). Another 2 ml of venous blood was collected again in sodium fluoride containing tube 2 hours after the patient had taken his regular meal for estimation of post prandial plasma glucose level. Blood samples were sent to an authenticated standard diagnostic laboratory where plasma glucose was estimated by Hexokinase method and thyroid hormone estimated using chemiluminescence method. Informed consent was taken prior to data collection.

Questionnaire:

The questionnaire was designed according to the needs of the present study. It includes questions regarding socio-demographic profile, history of common clinical symptoms of hypothyroidism and hyperthyroidism, duration of diabetes, presence of other comorbid conditions, and other risk factors.

Laboratory investigations:

a) Thyroid function test: To assess thyroid disorders, thyroid function test (T3, T4, TSH) was done using Chemiluminescence Immunoassay (CLIA) kit.

- Classification of the results will be based on the use of the following as normal reference range:

TSH: 0.5-4.7 mIU/ml
T3: 0.59-1.8 ng/mL
T4: 4.5 – 10.87 mcg/dl[9]

- **Hypothyroidism** – when T3, T4 were less and TSH greater than the reference ranges
- **Hyperthyroidism** – when T3, T4 were greater and TSH less than the reference ranges
- **Subclinical hypothyroidism** – when T3, T4 were within normal range and TSH greater than the reference ranges
- **Subclinical hyperthyroidism** – when T3, T4 were within normal range and TSH less than the reference ranges.

b) **Glycemic control:** The glycemic control was assessed by their fasting (FBS), postprandial glucose levels (PPBS) and glycated haemoglobin (HbA1c).

The glycemic control was graded as

- Euglycemic if FBS≤126 mg/dl and PPBS is ≥200 mg/dl
- Hyperglycemic if FBS is >126 mg/dl or PPBS is >200mg/dl [11]

RESULTS

Table 1 shows the sociodemographic characteristics of the study participants. Of the 380 study participants, 97(25.52%) were in the age group of 51 to 60 years, 113(29.73%) were in the age group of 61 to 70 years forming majority of the study participants. The average age of the study participant was 56.25 ±11.24 (mean ± S.D.) with a range of 32 to 80 years. 229 (60.26%) were females forming the majority of the portion and 151 (39.74%) were males. Majority of study participants, 123 (32.37%) belonged to class IV SES as per modified B.G. Prasad's classification; followed by 98 (25.79%) in class III. The duration of diabetes of the study participants varied with most of participants, 187 (49.21%) had diabetes from 1-5 years. The mean duration of illness of the study participants was 4.61±5.17 years with the range between 6 months and 25 years. The overall self-reported hypertension among the study participants was 116 (30.53%) study participants did not practice any regular physical activity. The mean duration of physical activity practiced were 46.06 ± 26.90 minutes. Prevalence of overweight and obesity based on BMI were 48.68% and 28.95% respectively. The overall prevalence of abdominal obesity based on waist-hip ratio criteria was 79.47% which was higher among women than that of men (95.19% vs. 71.85%). The prevalence of hypertension was 31.31%; grade I and grade II being 25.79% and 5.52% respectively. The overall prevalence of pre-hypertension was 43.95%. 107 (28.16%) were euglycemic and 273 (71.84%) were hyperglycemic. The mean serum FBS was 153.3 ± 46.25 and the mean serum PPBS was 229.18 ± 75.34.

Table 1: Distribution of study participants according to sociodemographic profile and risk factors (n=380)

Variables	Numbers	Percentage (%)
Age (years)		
30 – 40	45	11.85
41 – 50	90	23.69
51-60	97	25.52
61-70	113	29.73
>70	35	9.21
Sex		
Male	151	39.74
Female	229	60.26
Literacy status		
Illiterate	114	30.00
Primary School	86	22.63
Secondary School	89	23.42
Pre University	31	8.16
Diploma & Graduate	60	15.79
Occupation		
Government employee	37	9.74
Non - government employee	15	3.95
Self-employee	77	20.26
Home maker	212	55.79
Retired	39	10.26
Socio-economic status		
Class I	62	16.32
Class II	49	12.89
Class III	98	25.79
Class IV	123	32.37
Class V	48	12.63
Duration (in Years)		
<1	41	10.79
1-5	187	49.21
6-10	87	22.89
>10	65	17.11
Past medical history		

Hypertension	151	39.74
CHD + Hypertension	9	2.36
SLE + Hypertension	3	0.79
No past history	217	57.11
Family history of thyroid disorders		
Present	27	7.11
Absent	353	92.89
Tobacco Consumption		
Yes	61	16.05
No	319	83.95
Alcohol Consumption		
Yes	64	16.84
No	316	83.15
Physical activity during leisure time		
Walking	238	62.63
Yoga	23	6.05
Gym	3	0.79
No physical activity	116	30.53
Type of diet		
Vegetarian	187	49.21
Non – Vegetarian	193	50.79
BMI Categories		
Underweight (< 18.5)	7	1.84
Normal (18.5 – 22.9)	78	20.53
Overweight (23.0 – 27.5)	185	48.68
Obese (> 27.5)	110	28.95
Waist hip ratio (WHR)		
Normal	52	13.68
Abnormal	328	86.32
SBP categories		
Normal	147	38.68
Pre – hypertension	93	24.47
Hypertension grade I	86	22.63
Hypertension grade II	54	14.22
DBP categories		
Normal	94	24.74
Pre – hypertension	167	43.95
Hypertension grade I	98	25.79
Hypertension grade II	21	5.52
Glycemic Status		
Euglycemic	107	28.16
Hyperglycemic	273	71.84

Table 2 shows the overall prevalence of thyroid disorders among the study participants was 21.58% of which the most common thyroid disorder was subclinical hypothyroid with 13.68%. The overall prevalence of hypothyroid was 15.53 % and hyperthyroid was 6.05%. The mean T3 value was 1 ± 0.5 ng/ml with a range of 0.27 to 4.6ng/ml; mean T4 was 8.56 ± 1.48 µIU /ml with a range between 3.01 and 16.4 µIU /ml. TSH value of the participants ranged between 0.01 and 28.3 µg /dl with a mean value of 3.03 ± 2.85 µg/dl.

Table 2: Distribution of the participants according to thyroid disorders (n = 380)

Thyroid Disorders	Numbers	Percentage (%)
Euthyroid	298	78.42
Clinical Hypothyroid	7	1.85
Subclinical Hypothyroid	52	13.68
Clinical Hyperthyroid	15	3.94
Subclinical Hyperthyroid	8	2.11
Total	**380**	**100**

Graph 1: Distribution of the participants according to thyroid disorders

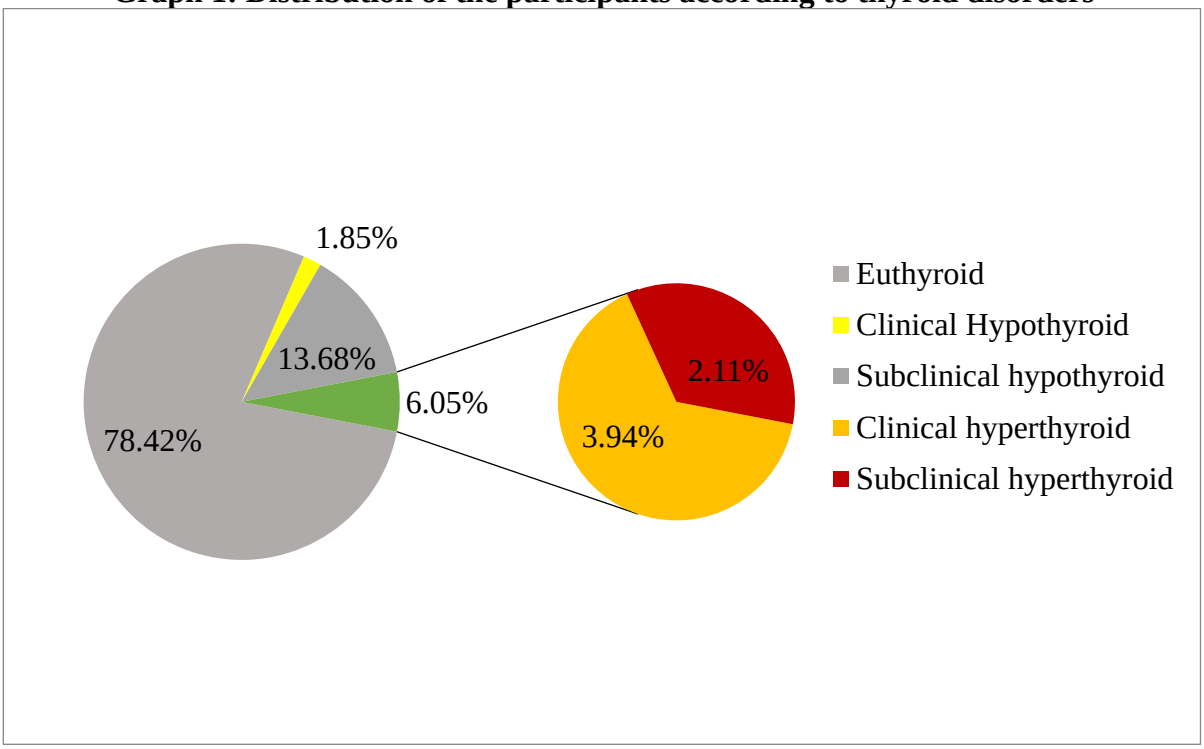

Table 3 describes various risk factors associated with the thyroid disorders in the study population. It was observed that the thyroid disorders were significantly higher among female study participants. The prevalence of thyroid disorders was seen more among the participants with hyperglycemia and with abdominal obesity (based on waist hip ratio). Thyroid disorders were also found to be significantly associated among those with past medical history of hypertension and those with no physical activity.

Table 3: Association of thyroid disorders with socio-demographic variables and risk factors.

Variables	**Number (%)**	**Euthyroid (%)**	**Thyroid disorders (%)**	**p-Value**
Age (years)				0.767
31 – 40	45(100)	33(73.33)	12(26.67)	
41 – 50	90(100)	68(75.56)	22(24.44)	
51-60	97(100)	77(79.39)	20(20.61)	
61-70	113(100)	92(81.42)	21(18.58)	
>70	35(100)	28(80.00)	7(20.00)	
Gender				
Male	**151(100)**	128 (84.77)	23 (15.23)	**0.031**
Female	**229 (100)**	170(74.24)	59(25.76)	
Literacy				
Illiterate	**114(100)**	92(80.71)	22(19.29)	0.205
Primary school	**86(100)**	61(70.93)	25(20.07)	
Secondary school	**89(100)**	68(76.41)	21(23.59)	
Pre-University II	**31(100)**	25(80.65)	6(19.35)	
Graduate	**60(100)**	52(86.67)	8(13.33)	
Socio-economic status				
Class I	62**(100)**	49(79.03)	13(20.97)	0.111
Class II	49**(100)**	42(85.71)	7(14.29)	
Class III	98**(100)**	79(80.61)	19(19.39)	
Class IV	123**(100)**	87(70.73)	36(29.27)	
Class V	48**(100)**	41(85.42)	7(14.58)	
Duration (in Years)				
Less than 1	41 **(100)**	30(73.17)	11(26.83)	0.702
1-5	187**(100)**	149(79.68)	38(20.32)	

5-10	87 **(100)**	70(80.56)	17(19.54)	
More than 10	65 **(100)**	49(75.38)	16(24.62)	
Self-reported Hypertension				
Present	163 **(100)**	136 (83.44)	27 (16.56)	**0.039**
Absent	217 **(100)**	162 (74.65)	55 (25.35)	
Family history				
Present	27 **(100)**	19 (70.37)	8 (29.63)	0.291
Absent	353 **(100)**	279 (79.04)	74(20.96)	
Tobacco Consumption				
Yes	64 **(100)**	51 (79.69)	13 (20.31)	0.0956
No	316 **(100)**	247 (78.16)	69 (21.84)	
Alcohol consumption				
Yes	p = 0.949	50 (78.12)	14 (21.88)	0.949
No	p = 0.949	248 (78.48)	68 (21.52)	
Physical activity				
Yes	264 (100)	215 (81.44)	49 (18.56)	0.047
No	116 (100)	83 (71.55)	33 (28.45)	
Type of diet				
Vegetarian	187 **(100)**	152 (81.28)	35 (18.72)	0.181
Non - Vegetarian	193 (100)	146 (75.64)	47 (24.36)	
BMI Categories				
Underweight (< 18.5)	7 (100)	5 (71.43)	2 (28.57)	0.78
Normal (18.5 – 22.9)	78 (100)	64 (82.05)	14 (17.95)	
Overweight (23.0 – 27.5)	185 (100)	145 (78.37)	40 (21.63)	
Obese (> 27.5)	110 (100)	84 (76.36)	26 (23.64)	
Waist hip ratio				
Normal	52 (100)	47 (90.38)	5 (9.62)	**0.023**
Abnormal	328(100)	251 (76.52)	77 (23.48)	
SBP categories				
Normal	62 (100)	40 (64.52)	22 (35.48)	**p = 0.014**
Pre – hypertension	178 (100)	145 (81.46)	33 (18.54)	
Hypertension grade I &II	140 (100)	113 (80.71)	27 (19.29)	
DBP categories				
Normal	94 **(100)**	72 (76.59)	22(23.41)	0.947
Pre – hypertension	167 **(100)**	132 (79.04)	35 (20.96)	
Hypertension grade I & II	119 **(100)**	94 (78.99)	25 (21.01)	
Glycemic Status				
Euglycemic	107 **(100)**	91 (85.05)	16 (14.95)	**0.049**
Hyperglycemic	273 **(100)**	207 (75.82)	66 (24.18)	

Table 4: Association of the thyroid disorder with presence of thyroid related symptoms (n = 380)

Symptoms	**Euthyroid (%)**	**Thyroid disorders (%)**	**Total (%)**
Asymptomatic	87(92.56%)	7(7.44%)	94 **(**100**)**
1 – 3	149(77.61%)	43(22.39%)	192 **(**100**)**
4 – 6	54(68.35%)	25(31.65%)	79 **(**100**)**
7 & above	8(53.33%)	7(46.67%)	15(100)
Total	**298(78.42)**	**82 (21.58)**	**380 (100)**
$\chi 2 = 21.479$	df = 3	p = 0.0008	

Table 4 shows association between thyroid related symptoms with the participants with thyroid disorders. The presence of more than 7 symptoms had high proportion of thyroid disorders (46.67%) followed by the participants with 4 – 6 symptoms (31.65%) and 1 – 3 symptoms (22.39%). This association between thyroid disorders and presence of increased number of symptoms was statistically significant ($\chi 2 = 21.479$, p = 0.0008).

Table 5: Distribution of study participants with thyroid disorders according to symptoms of thyroid disorder (n = 82)

SYMPTOMS	HYPOTHYROID	HYPERTHYROID
Fatigue	32 (78.05%)	9 (21.95%)
Difficulty in tolerating cold	13 (81.25%)	3 (18.75%)
Swelling in the neck	2 (40%)	3 (60%)
Constipation	16 (94.12%)	1 (5.88%)
Dry Skin	8 (88.89%)	1(11.11%)
Dry Hair / Alopecia	17 (77.27%)	5 (22.73)
Thick brittle nails	7 (87.5%)	1 (12.5%)
Facial puffiness	5 (100%)	0
Excessive sleepiness (Daytime)	6 (100%)	0
Weight gain	9 (81.82%)	2 (18.18%)
Increased appetite	1 (12.5%)	7 (87.5%)
Weight loss	8 (34.78%)	15 (65.22%)
Difficulty falling asleep / Insomnia	9 (40.91%)	13 (59.09%)
Hand tremor	0	7 (100%)
Warm skin	1(11.11%)	8 (88.89%)
Difficulty in tolerating heat	0	7 (100%)
Increased sweating	12 (66.67%)	6 (33.33%)

Among the study participants with thyroid disorders, symptoms which were exclusively found in individuals with hypothyroid were facial puffiness and excessive daytime sleepiness. Symptoms which were exclusively seen among individuals with hyperthyroid were difficulty in tolerating heat, hand tremor. Warm skin, difficulty falling asleep, increased appetite and swelling in the neck were predominantly seen among hyperthyroid individuals where the other symptoms were more commonly seen among participants with hypothyroid **(table 5)**.

Table 6: Multivariate Logistic Analysis: Association between various parameters with thyroid dysfunction

RISK FACTORS	ODDS RATIO (OR)	CONFIDENCE INTERVALS (C.I)	P - VALUE
Gender	1.614	0.893 – 2.915	0.113
Self-reported Hypertension	0.528	0.307 – 0.909	0.021
Systolic Hypertension	0.438	0.235 – 0.814	0.009
No physical activity during leisure time	1.496	0.876 – 2.553	0.140
Waist Hip Ratio (WHR)	2.400	0.863 – 6.672	0.093
Glycemic status	**1.852**	0.996 – 3.443	**0.051**

Table 6 showed multivariate analysis demonstrated the odds ratio and 95% CI for different risk factors for thyroid dysfunction, hyperglycemic status was the strongest risk factor with an odds ratio (OR) 1.85 (95% CI, 0.996 – 3.443) with p value 0.05.

DISCUSSION

Prevalence of thyroid dysfunction in type 2 diabetes mellitus patients become an attention in epidemiological studies in the field of endocrinology in the last decade. This study obtained proportion of hypothyroidism and hyperthyroidism in type 2 diabetes mellitus patients. Among the 380 study participants, the overall prevalence of thyroid disorders was found to be 21.58% and the most common thyroid disorder was subclinical hypothyroid with 13.68%. Our observations are in consistence with the previous similar studies performed in India and other countries. Jali et al. reported a prevalence of 16.2%.[12] Madavaram Sreelatha et al. reported a prevalence of 13.1% with most common thyroid disorder as subclinical hypothyroidism.[13] Bilal Wani et al. reported a prevalence of 17.3% with subclinical hypothyroidism (9%) as the most common disorder, in Delhi.[14] A study conducted in Assam by Anuradha Deurieta et al. reported 22.5% with subclinical hypothyroidism (14.1%).[15] Higher prevalence was observed in studies conducted by Maaz Ozair et al., in Aligarh (28%), Nidhi Kaely et al., in Uttarkhand (24%) and Navneet Agarwal et al., in Gwalior (27.8%).[16][17][18] Another study done by Palma CC et al had reported a prevalence of 14.7% in

patients with diabetes.[19] Papazafiropalou et al did a similar study in Greek and reported that the overall prevalence of thyroid dysfunction in T2DM patients to be 12.3%.[20]

Among 229 female study participants, 58 (25.33%) showed presence of thyroid dysfunction. Thyroid disorder in female participants 71.95% (59/82) were more in number when compared with male participants 28.05% (23/82). Compared between patients with normal and abnormal thyroid profile the difference is statistically significant (P = 0.014). Jali et al., et al., and Madavaram Sreelatha et al. in their studies found that the prevalence of thyroid dysfunction was significantly higher in the female than in the male diabetic patients.[12][13]

In our study, prevalence of thyroid disorders was found more among those who did not practice any physical activity during leisure time (28.45%). Compared with normal thyroid profile group, it was statistically significant. In our study, participants with presence of more than 7 symptoms had high proportion of thyroid disorders (46.67%) followed by the participants with 4 – 6 symptoms (31.65%) and 1 – 3 symptoms (22.39%). This association between thyroid disorders and presence of increased number of symptoms was statistically significant ($\chi 2 = 21.479$, $p = 0.0008$). The prevalence of thyroid disorders increased with increasing number of symptoms related to thyroid disorders. Symptoms which were seen in higher proportion in hypothyroid disorders participants were facial puffiness, excessive daytime sleepiness, and constipation, difficulty in tolerating cold, fatigue, dry skin and dry hair. Symptoms which were seen in mostly in individuals with hyperthyroid disorders were difficulty in tolerating heat, hand tremor, increased appetite, and swelling in the neck. A study conducted by Manjunath C et al. in Bangalore reported that the common symptoms seen among subclinical hypothyroid were dry skin, fatigue and poorer memory. [21] Out of 82 patients with abnormal thyroid profile, 48.78% (40/82) had overweight and 31.71% (26/82) were obese. The mean BMI of the patients with altered thyroid profile was 26.01 Kg/m2 compared to 25.93 Kg/m2 in patients with normal thyroid profile. However, there was no significant correlation between BMI and abnormal thyroid profile. This observation was similar to the findings of the studies conducted by Madavaram Sreelatha et al. and Maaz Ozair et al.[13][16] In our study, the prevalence of thyroid disorders with abdominal obesity assessed by WHR was 23.48% respectively. Association of WHR and abnormal thyroid profile was statistically significant. Out of 82 participants with abnormal thyroid profile, 66 (80.49%) of the participants were hyperglycemic and 16 (19.15%) were euglycemic. The mean FBS and PPBS of the participants among the participants with altered thyroid profile were 161.7 and 243.8 mg/dl and were 150.3 and 224.3 among normal thyroid profile were respectively. The association between thyroid disorders and hyperglycemic state was found statistically significant. This findings was on par with the study conducted by Bharat et al., Manipur.[22] In our study hypothyroidism and hyperthyroidism in Type 2 Diabetes Mellitus was seen to be significantly associated with the gender of the participants and physical activity during leisure time with p value 0.048 and 0.03 respectively, waist hip ratio ($p = 0.07$) and with glycemic status (p value =0.139). This observation is consistent with the study conducted by Jali et al. which showed females are at increased risk of developing hypothyroidism and hyperthyroidism.[12] Most of the study participants 192 (50.52%) had 1 to 3 symptoms, 20.79% had 4 to 6 symptoms and 15 (3.95%) had more than 7 symptoms. 94 (24.74%) of the subjects were asymptomatic. The most common symptom reported by the participants were fatigue (48.60%), followed by sleep disturbances (31.12%), constipation (23.42%), muscle cramps (23.42%). This observation could be due to overlapping clinical signs and symptoms between thyroid disorder and diabetes mellitus.

In our study, univariate analysis showed significant association between thyroid disorders and gender, waist hip ratio, hyperglycemic status, and physical activity during leisure time. Multivariate analysis of these variables demonstrated hyperglycemic status with significant association with an odds ratio (OR) of 1.85 (95% CI, 0.996 – 3.443) with p value 0.05. In a study conducted by Papazafiropoulou et al. multivariate analysis demonstrated, after controlling for BMI, that presence of thyroid dysfunction was related only with gender (OR: 0.220, 95% CI: 0.141 - 0.352) and LDL- cholesterol levels (OR: 0.990, 95% CI: 0.985 - 0.995).[20]

CONCLUSION

The present cross sectional study reported a high prevalence of thyroid disorders to be 21.58%. Sub-clinical hypothyroidism was more common than other conditions which constituted 13.68% of the thyroid dysfunction in the type 2 diabetes mellitus patients. Clinical hypothyroidism was 1.85%, hyperthyroidism was 6.05% [clinical hyperthyroidism (3.94%) and subclinical hyperthyroidism (2.11%)]. Thyroid disorders are more in females (25.33%) than males (15.89%). Though symptoms were overlapping between the hypothyroid and hyperthyroid subjects, symptoms which were predominantly seen among hypothyroid individuals were facial puffiness, excessive daytime sleepiness, constipation, dry skin and thick brittle nails, weight gain, difficulty in tolerating cold and fatigue. Similarly, symptoms which were predominantly seen among hyperthyroid individuals were hand tremors and difficulty in tolerating heat. Our study showed high hyperglycemic individuals (71.84%) based on FBS and PPBS even with regular treatment indicating poor management of type 2 diabetes mellitus in the community. Abnormal thyroid dysfunction with hyperglycemic status (80.49%) showed a significant association. In addition, presence of thyroid dysfunction was significantly associated with not involving in any physical activity during leisure time, increased waist hip ratio. Multivariate analysis demonstrated the presence of thyroid disorder was related with glycemic status of the participants with odds ratio 1.85 (CI, 0.996 – 3.443). Based on the high prevalence of thyroid dysfunction among type 2 diabetes mellitus patients regular screening and early intervention should be done especially in females with T2DM patients. Strong suspicion of thyroid dysfunction in patients with uncontrolled glycemic levels should be taken into account in the comprehensive management of diabetes mellitus.

REFERENCES:

1. International Diabetes Foundation. International Diabetes Foundation. 2021
2. World Health Organization (Who). Obesity: Preventing And Managing The Global Epidemic. Report Of A Who Consultation. (1-253).World Health Organ Tech Rep Ser. 2000;894:I–Xii.
3. Pradeepa R, Anjana Rm, Joshi Sr, Et Al. Prevalence Of Generalized & Abdominal Obesity In Urban & Rural India--The Icmr-Indiab Study (Phase-I) [Icmr- Ndiab-3]. *Indian J Med Res*. 2015;142(2):139–150. Doi:10.4103/0971-5916.164234
4. American Association Of Diabetes Educators, Chicago, Il, August 2018.
5. Damian J. Damian, Kelvin Kimaro, Godwin Mselle, Rose Kaaya And Isaac Lyaruu. Prevalence Of Overweight And Obesity Among Type 2 Diabetic Patients Attending Diabetes Clinics In Northern Tanzania. Bmc Research Notes (2017) 10:515
6. Ahmad Shirafkan And Abdoljalal Marjani. Prevalence Of Obesity Among Type 2 Diabetes Mellitus In Gorgan (South East Of Caspian Sea), Iran. World Applied Sciences Journal 14 (9): 1389-1396, 2011
7. Rao C, Kamath V, Shetty A, Kamath A. A Study On The Prevalence Of Type 2 Diabetes In Coastal Karnataka. Int J Diabetes Dev Ctries 2010;30(2):80
8. Singh T, Sharma S, Nagesh S. Socio-Economic Status Scales Updated For 2017. Int J Res Med Sci 2017;5(7):3264
9. Joshi Sr. Laboratory Evaluation Of Thyroid Function. J Assoc Physicians India 2011;59 Suppl(January):14–20.
10. Hsio- M, Wiedmeyer M. Laboratory Procedure Manual Plasma Glucose Enzyme Hexokinase (Hk). :1–14.
11. Who. Definition And Diagnosis Of Diabetes Mellitus And Intermediate Hyperglycemia. Who2 2006;50.
12. Jali Mv, Kambar S, Jali Sm, Pawar N, Nalawade P. Prevalence Of Thyroid Dysfunction Among Type 2 Diabetes Mellitus Patients. Diabetes Metab Syndr. 2017 Nov;11 Suppl 1:S105-S108. Doi: 10.1016/J.Dsx.2016.12.017. Epub 2016 Dec 19. Pmid: 28057505.
13. Sreelatha M, Kumar Vs, Shekar Gc, Shekar Vc. Study Of Thyroid Profile In Patients With Type 2 Diabetes Mellitus. 2017;5(2):211–20

14. Setare Nassiri, Mohammad Vakili, Hamide Gholami And Setare Akhavan 2018. "Prevalence Of Thyroid Dysfunction In Patients Of Type 2 Diabetes Mellitus: Hospital Based Prospective Study", International Journal Of Current Research 10, (03), 67031-67034.
15. Dr Anuradhadeurietal, 2016. (22. 5%)1: Prospective Study Of Thyroid Dysfunction In Patients With Type 2 Diabetes Mellitus In A Tertiary Care Hospital, Assam, India. Iosr Journal Of Dental And Medical Sciences, Volume 15, Issue 7 Ver. Ii, Pp21-25).
16. Ozair, Maaz & Noor, Saba & Raghav, Alok & Siddiqi, Sheelu & Chugtai, Anjum & Ahmad, Jamal. (2017). Prevalence Of Thyroid Disorders In North Indian Type 2 Diabetic Subjects: A Cross Sectional Study. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 12. 10.1016/J.Dsx.2017.12.016.
17. Kaeley, Nidhi & Bhatia, Rohan & Dhar, Minakshi & Verma, Sanjiv & Ahmad, Sohaib. (2015). Kaeley Et Al.: Association Of Thyroid Disorders And Type 2 Diabetes Mellitus Association Of Thyroid Disorders And Type 2 Diabetes Mellitus-Beyond Coincidence-A Hospital Based Study From Sub-Himalayan Region.
18. Navneet Agrawal, Manoj Gulati. Study Of Prevalence Of Thyroid Dysfunction In Patients With Type 2 Diabetes Mellitus. International Journal Of Contemporary Medical Research 2016;3(8):2212-2214
19. Palma Cc, Pavesi M, Nogueira Vg, Clemente El, Vasconcellos Mde F, Pereira Lc Júnior, Pacheco Ff, Braga Tg, Bello Lde F, Soares Jo, Dos Santos Sc, Campos Vp, Gomes Mb. Prevalence Of Thyroid Dysfunction In Patients With Diabetes Mellitus. Diabetol Metab Syndr. 2013 Oct 9;5(1):58. Doi: 10.1186/1758-5996-5-58. Pmid: 24499529; Pmcid: Pmc3852595.
20. Papazafiropoulou, A., Sotiropoulos, A., Kokolaki, A. Et Al. 2010. Prevalence Of Thyroid Dysfunction Among Greek Type 2 Diabetic Patients Attending An Outpatient Clinic. J Clinical Medicine Research, 2 (2): 75-8. 5.
21. Manjunath Sc, Krishnamurthy V, Puttaswamy Bk, Prabhu S, Vishwanathaiah Pm. Prevalence Of Subclinical Thyroid Disorders In Type 2 Diabetes Mellitus. Int J Med Public Health 2013;3:330-4.
22. Bharat, Hijam D, Gangte D, Lalnunpui, Premchand, Et Al. (2013) Thyroid Status In Diabetes Mellitus. J Glycomics Lipidomics 3: 106. Doi:10.4172/2153 0637.1000106