Original Article

Thyroid Status in Patients with Type 2 Diabetes Mellitus Attending a Tertiary Care Hospital in Cumilla, Bangladesh

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Abstract

Background: *Thyroid dysfunction is widely reported to be more prevalent in patients with type 2 diabetes mellitus (T2DM) across different regions of the world; however, there is limited data available on this in our local context.* The present study aimed to evaluate the *thyroid dysfunction in patients with T2DM and find out the relationship with HbA1c.* ***Materials and Methods:*** *This cross-sectional study was carried out in Eastern Medical College Hospital from June 2024 to November 2024. Sixty (60) diagnosed type 2 diabetic patients and Sixty (60) nondiabetic people with the age range of 31 to 70 years were taken by convenience sampling. Permission for the study was taken from the IERB of EMC. Informed consent was obtained from each participant prior to sample collection. Patients with type 1 diabetes, gestational diabetes, thyroid cancer, thyroid surgery, renal and liver failure were excluded from the study. All the data was processed and analyzed using Microsoft Excel and IBM-SPSS v25.0.* ***Results:*** The mean age was *48.55±8.6 years in the diabetic group and 42.41±9.8 years in the non-diabetic group). Serum TSH and FT3 were significantly higher in type 2 diabetic patients than those of non-diabetic people in this study. But there was no significant difference in serum FT4 between two groups. Among type 2 diabetic cases, 12 (20%) had thyroid dysfunction and in non-diabetics, 05 (8.2%) had thyroid dysfunction. Among cases 5 (8.3%) had hypothyroidism, 6 (10%) had subclinical hypothyroidism, 1 (1.6%) had hyperthyroidism. Among non-diabetic subjects 1 (1.6%) had hypothyroidism, 3 (5%) had subclinical hypothyroidism, 1 (1.6%) had hyperthyroidism. There was a positive significant correlation of HbA1c with TSH and FT3 but not with FT4 in the study cases.* ***Conclusion:*** *Diabetic complications and diabetes-related metabolic and demographic factors are related to abnormal thyroid hormone levels. Therefore, routine testing of thyroid hormones in diabetic patients is essential, as it can aid in the early detection of thyroid-related complications.*

Keywords: Type 2 diabetes mellitus, Glycosylated haemoglobin, Thyroid Hormones.
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Introduction

Diabetes Mellitus (DM) is one of the leading global health challenges and is rapidly reaching epidemic proportions[1]. It is estimated that it would increase by 2045 to 629 million and 4 out of 5 people affected by diabetes mellitus are reported to be from low income and middle-income countries[2]. In 2017, approximately 462 million individuals, about 6.28% of the world's population, were affected by type 2 diabetes. The prevalence is projected to increase to 7079 individuals per 100,000 by 2030, reflecting a continued rise across all regions of the world[3]. Several micro- and macrovascular complications of diabetes arise with the increasing duration of diabetes and poor glycaemic control[4]. Diabetes mellitus and thyroid dysfunction remain the two most observed endocrine disorders in routine clinical practice[5]. Consequently, it is common for an individual to experience both thyroid disorders and diabetes simultaneously[6,7].

The thyroid gland is composed of thyroid follicles which synthesize and store thyroid hormone. The hypothalamus secretes thyroid-releasing hormone (TRH), which prompts the thyrotroph cells in the anterior pituitary to produce and release thyroid-stimulating hormone (TSH). TSH is released by the anterior pituitary and stimulates the thyroid follicular cells to release thyroxine, T4 (80%) and triiodothyronine, T3 (20%). The production of thyroid hormones relies on the presence of iodide, stimulation by TSH, and the availability of tyrosine residues on thyroglobulin (TG). Once T4 is released into the bloodstream, it can be converted into the more active T3 via deiodination. Both T4 and T3 regulate their own production through negative feedback: elevated levels suppress TSH secretion, while low levels lead to increased TSH release from the anterior pituitary[8]. Thyroid dysfunction

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encompasses a range of conditions affecting the thyroid gland, characterized by abnormal levels of T3, T4 and altered levels of circulating TSH. It can manifest in various forms, including thyroid enlargement (either diffuse or nodular), symptoms associated with low thyroid hormone levels (hypothyroidism), symptoms of excessive thyroid hormone production (hyperthyroidism), or, in some cases, may be asymptomatic, representing a subclinical state[9].

Previous research has indicated that thyroid dysfunction occurs more frequently in individuals with type 2 diabetes mellitus (T2DM) compared to the general population[10,11]. The association between diabetes and thyroid dysfunction was first reported in 1979[12]. The prevalence of thyroid dysfunction in diabetes varies from 2.2% to 46.5%[11-14]. The coexistence of thyroid dysfunction in individuals with T2DM can exacerbate both macro- and microvascular complications, leading to increased morbidity, mortality, and a reduced quality of life[15]. Detecting dysfunction of the thyroid gland in T2DM will inform clinicians to give optimal treatment for this dysfunction. So, we evaluated thyroid dysfunction by measuring the levels of serum free T3 (FT3), free T4 (FT4) and TSH in subjects with T2DM and determined the correlation among various metabolic parameters such as FBS, HbA1C and Body Mass Index (BMI) in the study cases.

Materials and Methods

This cross-sectional study was carried out in Eastern Medical College Hospital (EMCH) from June 2024 to November 2024. Sixty (60) diagnosed type 2 diabetic patients and Sixty (60) nondiabetic people with the age range of 31 to 75 years were taken by convenience sampling. Permission for the study was taken from the Ethical Review Committee of EMC (EMC/2024/349-A). Informed consent was obtained from each participant prior to sample collection. Data were collected by pre-designed questionnaire containing all the variables of interest and fulfilling the exclusion & inclusion criteria for the study population. Patients with type 1 diabetes, gestational diabetes, thyroid cancer, thyroid surgery, renal and liver failure were excluded from the study.

Fasting venous blood samples were collected from each participant under strict aseptic precautions using a sterile disposable syringe. Then FBS, HbA1c, serum FT3, FT4 and TSH were measured. Participants with elevated TSH levels accompanied by low FT3 and FT4 were classified as having primary hypothyroidism, while those with elevated TSH but normal FT3 and FT4 levels were considered to have subclinical hypothyroidism. Besides, those who had low TSH and high FT3 & FT4 were regarded to have primary hyperthyroidism; those who had low TSH but with normal FT3 & FT4 were taken to have subclinical hyperthyroidism[16]. The reference range for TSH was 0.35–5.5 µIU/ml, for FT3 it was 2.3–4.2 pg/ml and for FT4 it was 0.89–1.76 ng/dL[17]. All the data was processed and analyzed using Microsoft Excel and IBM-SPSS v25.0 for Windows. p-value <0.05 was regarded statistically significant. Variables were expressed as mean ± standard deviation (SD). To see the statistical differences Student's 't' test was used and to see the correlation Pearson's correlation coefficient was used. The results were expressed in the form of tables and figures with the appropriate interpretation.

Results

In this cross-sectional study, one hundred and twenty (120) participants with the age range of 31-75 years were included. Among them 60 cases were diagnosed type 2 diabetic patients in which 24 (40%) were male and 36 (60%) were female. Besides, 60 participants were non-diabetic people in which 28 (46.7%) were male and 32 (53.3%) were female (figure 1). The mean age was 48.55±8.6 years in the diabetic group and 42.41±9.8 years in the non-diabetic group (table I). Table-I shows that there were significant differences of FBS, HbA1c% and BMI in between type 2 diabetic patients and non-diabetic people. Table-I also demonstrates that serum TSH and FT3 were significantly higher in type 2 diabetic patients than those of non-diabetic people in this study (4.10±2.80 vs 2.26±2.73 µIU/ml and 3.26±0.69 vs 2.94±0.85 µIU/ml). But there was no significant difference in serum FT4 between two groups (1.1±0.26 vs 1.2±0.53).

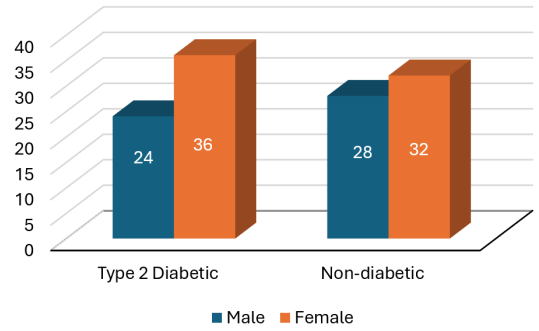

Figure-1: Gender distribution of the study cases (n=120)

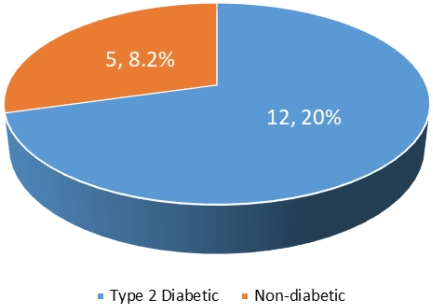

Figure-2: Incidence of thyroid disorders in this study (n=120)

Among type 2 diabetic cases, 12 (20%) had thyroid dysfunction and in non-diabetics, 05 (8.2%) had thyroid dysfunction (figure 2). Among cases 5 (8.4%) had hypothyroidism, 6 (10%) had subclinical hypothyroidism, 1 (1.6%) had hyperthyroidism. Among non-diabetic subjects 1 (1.6%) had hypothyroidism, 3 (5%) had subclinical hypothyroidism, 1 (1.6%) had hyperthyroidism. But no patient was diagnosed with subclinical hyperthyroidism in both groups. There was a positive significant correlation of HbA1c with TSH and FT3 but not with FT4 in the study cases (figure 3-5).

Table-I: Comparison of FBS, HbA1c, serum TSH, FT3, FT4 and BMI between type 2 diabetic patients and non-diabetic people (n=120)

Variables	Type 2 Diabetic (n=60) Mean±SD (Range)	Non-diabetic (n=60) Mean±SD (Range)	p-value	Significance
Age (years)	48.55±8.6 (31-68)	42.41±9.8 (31-72)	p=0.003	Significant
FBS (mmol/l)	9.65±3.8 (5.2-25.2)	5.35±0.35 (4.3-5.9)	p<0.00001	Significant
HbA1c (%)	8.4±2.18 (5.8-14.2)	5.37±0.28 (4.5-5.6)	p<0.00001	Significant
BMI (kg/m^2)	26.93±4.56 (17.4-39.6)	23.02±1.66 (18.7-24.8)	p<0.00001	Significant
S. TSH (µIU/ml)	4.10±2.80 (0.12-13.3)	2.26±2.73 (0.05-9.95)	p=0.005	Significant
S. FT3 (ng/dL)	3.26±0.69 (1.25-4.4)	2.94±0.85 (1.9-8.76)	p=0.03	Significant
S. FT4 (ng/dL)	1.1±0.26 (0.6-2.4)	1.2±0.53 (0.74-4.75)	p=0.10	Not Significant

*p value obtained from 't' test

Table-II: Thyroid profile of the study participants (n=120)

Thyroid Function	Type 2 Diabetic (n=60)			Non-diabetic (n=60)		
	Male (n=24)	Female (n=36)	Total (%)	Male (n=28)	Female (n=32)	Total (%)
Normal Thyroid Function	19	29	48 (80%)	25	30	55 (91.8%)
Hypothyroidism	02	03	05 (8.4%)	00	01	01 (1.6%)
Subclinical hypothyroidism	02	04	06 (10%)	02	01	03 (5%)
Hyperthyroidism	01	00	01 (1.6%)	01	00	01 (1.6%)
Subclinical hyperthyroidism	00	00	00	00	00	00
Sub-total	**24**	**36**	**60 (100%)**	**28**	**32**	**60 (100%)**

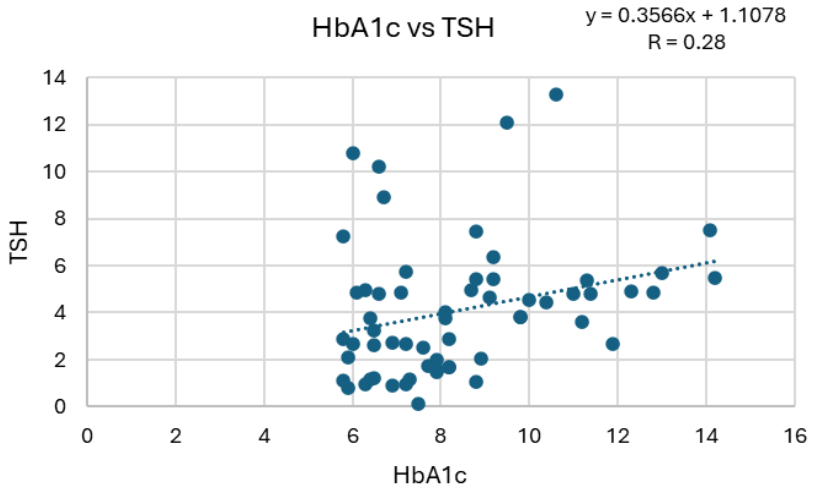

Figure-3: Scatter diagram showing the correlation between HbA1c and TSH in the study cases (r=0.28, p=0.03)

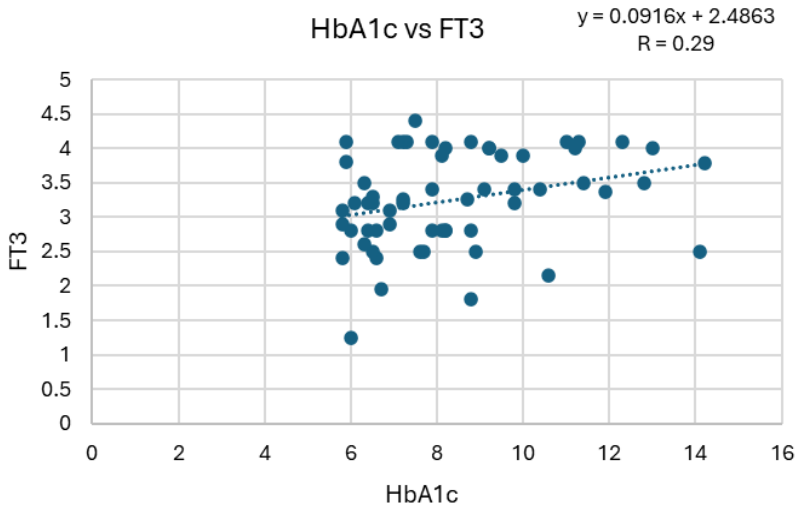

Figure-4: Scatter diagram showing the correlation between HbA1c and FT3 in the study cases (r=0.29, p=0.02)

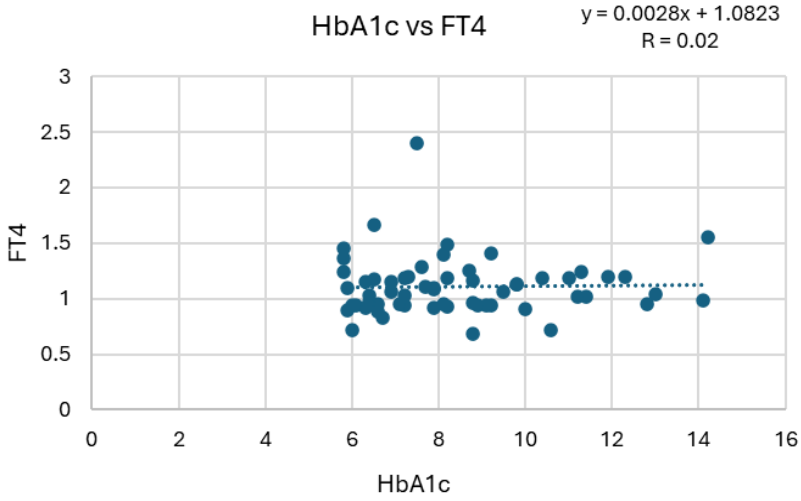

Figure-5: Scatter diagram showing the correlation between HbA1c and FT3 in the study cases (r=0.02, p=0.88)

Discussion

Diabetes mellitus and thyroid disorders are the most frequently observed endocrine disorders in clinical practice. Insulin and thyroid hormones together play vital roles in cellular metabolism; a disturbance in one of them, whether by increase or decrease, may result in an abnormal function of the other[7]. In this study, the mean age of patients with type 2 diabetes mellitus (T2DM) was 48.55 years. This may be due to the fact that the prevalence of T2DM increases with age[18]. The mean HbA1C (8.4±2.18) was significantly higher in type 2 diabetic cases. This could reflect the poor glycemic status of most diabetic patients in our study who did not achieve a glycaemic goal, which reflects the pattern in earlier study[19].

In our study, T2DM patients had lower mean serum TSH and FT3 levels compared to the non-diabetic people. Besides, no difference was observed between serum FT4 between the two groups. Similar results were also observed by Elgazar, et al[20] study. A significant variation in serum TSH, FT4, and FT3 levels between the two groups were reported by Li, et al[21] and Kaur et al.[22] Besides Ogbonna, et al[16] showed the significant difference of serum FT3 between type 2 diabetic and non-diabetic people but not serum TSH and FT4. Among type 2 diabetic cases, 20% had thyroid dysfunction and in non-diabetics, 8.2% had thyroid dysfunction in this study. This finding was in line with other studies which documented that the overall prevalence of thyroid dysfunction among diabetic patients was 29% and 20.16% while the prevalence of 5% and 9.2% in non-diabetic people[20,23]. A study by Mehalingam, et al[17] reported a 17.5% prevalence of thyroid disease in patients with type 2 diabetes.

Among the spectrum of thyroid disorders, subclinical hypothyroidism was the most observed disorder in both type 2 diabetic cases (10%) and in non-diabetic people (5%) in this study which was similar to that observed by Sree Madhurya Reddy, et al[23] and Jalal, et al[24]. Similarly, in the study by Telwani et al[25], subclinical hypothyroidism was the most common thyroid disorder in diabetic patients

(16%), while hyperthyroidism was the least frequent (1%). This may be attributed to the disruption of the thyroid-stimulating hormone (TSH) response to thyrotropin-releasing hormone (TRH) in individuals with T2DM, ultimately leading to hypothyroidism and decreased T3 levels. In addition, impairments in the peripheral conversion of T4 to T3 may also contribute to low T3 levels in individuals with poorly controlled diabetes[26]. In our study, only 1.6% were hyperthyroid in both groups. Besides, no patient was found to be diagnosed with subclinical hyperthyroidism like the study by Asuti, et al[13].

Regarding gender distribution, thyroid dysfunctions were predominant in female compared to male cases (7 vs 5), accounting for 11.7% female cases. A similar predominance of female patients was also reported by the Diabcare Nigeria Study Group in 2012[19]. A significant positive correlation was observed between HbA1c and both TSH and FT3 among the study participants. But no correlation was found between HbA1c levels and FT4. Parallel results were observed in other studies[22,27]. Elgazar, et al[20] reported a significant negative correlation between serum FT3 and HbA1c as well as a significant positive correlation between serum TSH levels and HbA1c. In a similar fashion, another study confirmed a weak positive correlation between HbA1c and TSH[23].

Conclusion

The connection between thyroid dysfunction and diabetes has been repeatedly proven. Presence of abnormal thyroid hormone levels in diabetics, if unrecognized, may be a primary cause of poor management. Therefore, routine testing of thyroid hormones in diabetic patients is essential, as it can aid in the early detection of thyroid-related complications. It is recommended to do larger studies on the association of thyroid dysfunction with chronic complications of type 2 diabetes.

Conflict of Interest

The authors declared that they have no conflicts of interest.

Acknowledgement

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References

1. International Diabetes Federation. IDF Diabetes Atlas 8th Edition. Brussels, Belgium: International Diabetes Federation; 2017. Available at: https://www.idf.org/e-library/epidemiologyresearch/diabetes-atlas/134-idf-diabetes-atlas-8thedition.html. [Accessed on August 12, 2024]
2. International Diabetes Federation. IDF Diabetes Atlas, 5th Ed. Brussels, Belgium: International Diabetes Federation; 2011. Available at: https://www.idf.org/e-library/epidemiologyresearch/diabetes-atlas/20-atlas-5th-edition.html. [Accessed on August 12, 2024]
3. Khan MAB, Hashim MJ, King JK, Govender RD, Mustafa H, Al Kaabi J. Epidemiology of Type 2 Diabetes - Global Burden of Disease and Forecasted Trends. J Epidemiol Glob Health. 2020; 10 (1): 107-11. doi: 10.2991/jegh.k.191028.001.
4. Forbes JM, Cooper ME. Mechanisms of diabetic complications. Physiol Rev. 2013; 93 (1): 137-88. doi: 10.1152/physrev.00045.2011.
5. Elmenshawi IM, Alotaibi SS, Alazmi AS, Alazmi AM, Alruwaili FR, Alazmi NN, et al. Prevalence of thyroid dysfunction in diabetic patients. J Diabetes Metab Disord Control. 2017; 4 (2): 55-60. DOI: 10.15406/jdmdc.2017.04.00106
6. Singh G, Gupta V, Sharma AK, Gupta N. Evaluation of Thyroid Dysfunction Among type 2 diabetic Punjabi Population. Adv Biores. 2011; 2 (2): 3-9.
7. Sathish R, Mohan V. Diabetes and thyroid diseases: A review. Int J Diab Dev Ctries. 2003; 23: 120-3.
8. Pirahanchi Y, Tariq MA, Jialal I. Physiology, Thyroid. In: StatPearls. Treasure Island (FL): StatPearls Publishing. Available at: https://www.ncbi.nlm.nih.gov/books/NBK519566. [Accessed on August 12, 2024]
9. Papazafiropoulou A, Sotiropoulos A, Kokolaki A, Kardara M, Stamataki P, Pappas S. Prevalence of thyroid dysfunction among greek type 2 diabetic patients attending an outpatient clinic. J Clin Med Res. 2010; 2 (2): 75-8. doi: 10.4021/jocmr2010.03.281w.
10. Udiong CE, Udoh AE, Etukudoh ME. Evaluation of thyroid function in diabetes mellitus in Calabar, Nigeria. Indian J Clin Biochem. 2007; 22 (2): 74-8. doi: 10.1007/BF02913318.
11. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2012; 35: S11-S19. doi: 10.2337/dc12-s011.
12. Gray RS, Irvine WJ, Clarke BF. Screening for thyroid dysfunction in diabetics. Br Med J. 1979; 2 (6202): 1439. doi: 10.1136/ bmj.2.6202.1439-a.
13. Asuti S, Purad S, Hosamani P. Pattern of Thyroid Dysfunction in Type II Diabetes Mellitus Patients in a Tertiary Care Center: A Cross-Sectional Study. J Med Sci Health. 2023; 9 (2): 204-10. doi: 10.46347/jmsh.v9i2.23.125.
14. Ghazali SM, Abbiyesuku FM. Thyroid dysfunction in type 2 diabetics seen at the

University College Hospital, Ibadan, Nigeria. Niger J Physiol Sci. 2010; 25 (2): 173-9.
15. Wang C. The Relationship between Type 2 Diabetes Mellitus and Related Thyroid Diseases. J Diabetes Res. 2013; 2013: 390534. doi: 10.1155/2013/390534.
16. Ogbonna SU, Ezeani IU, Okafor CI, Chinenye S. Association between glycemic status and thyroid dysfunction in patients with type 2 diabetes mellitus. Diabetes Metab Syndr Obes. 2019; 12: 1113-22. doi: 10.2147/DMSO.S204836.
17. Mehalingam V, Sahoo J, Bobby Z, Vinod KV. Thyroid dysfunction in patients with type 2 diabetes mellitus and its association with diabetic complications. J Family Med Prim Care. 2020; 9 (8): 4277-81. doi: 10.4103/jfmpc.jfmpc_838_20.
18. Akbar DH, Ahmed MM, Al-Mughales J. Thyroid dysfunction and thyroid autoimmunity in Saudi type 2 diabetics. Acta Diabetol. 2006; 43 (1): 14-8. doi: 10.1007/s00592-006-0204-8.
19. Okafor CI, Ofoegbu EN. Control to goal of cardiometabolic risk factors among Nigerians living with type 2 diabetes mellitus. Niger J Clin Pract. 2012; 15 (1): 15-8. doi: 10.4103/1119-3077.94089.
20. Elgazar EH, Esheba NE, Shalaby SA, Mohamed WF. Thyroid dysfunction prevalence and relation to glycemic control in patients with type 2 diabetes mellitus. Diabetes Metab Syndr. 2019; 13 (4): 2513-7. doi: 10.1016/j.dsx.2019.07.020.
21. Li Y, Yi M, Deng X, Li W, Chen Y, Zhang X. Evaluation of the Thyroid Characteristics and Correlated Factors in Hospitalized Patients with Newly Diagnosed Type 2 Diabetes. Diabetes Metab Syndr Obes. 2022; 15: 873-84. doi: 10.2147/DMSO.S355727.
22. Kaur I, Kaur D, Kaur M, Sibia RPS, Massaon HK. Correlation of T3, T4, TSH with fasting plasma glucose and glycosylated haemoglobin in patients of type 2 diabetes mellitus. Int J Clin Biochem Res. 2020; 7 (3): 338-42.
23. Sree Madhurya Reddy M, Seshadri S. A study of thyroid dysfunction in type 2 diabetes mellitus in tertiary care center. Int J Contemp Med Res. 2020; 7 (1): A22-6. doi: 10.21276/ijcmr.2020.7.1.48.
24. Jalal MJ, Riyas B, Kumar AP. Thyroid dysfunction in patients with Type-2 diabetes mellitus in Kerala: A case-control study. Thyroid Res Pract. 2019; 16 (1): 3-5. doi: 10.4103/trp.trp_47_18.
25. Telwani AA, Wani ZH, Ashraf Y, Shah AA. Prevalence of thyroid dysfunction in type 2 diabetes mellitus: a case control study. Int J Res Med Sci. 2017; 5 (10): 4527-31. doi: 10.18203/2320-6012.ijrms20174590.
26. Fakhroo A, Elhadary MR, Elsayed B, Al-Kuwari A, Aly R, Mesilhy R, et al. Association of Subclinical Hypothyroidism with Type 2 Diabetes Mellitus in Qatar: A Cross-Sectional Study. Diabetes Metab Syndr Obes. 2023; 16: 3373-9. doi: 10.2147/DMSO.S428987.
27. Makandar AD, Sonag AD, Imdad T, Shylaja TV. Correlation between glycemic control and thyroid status in patients with type 2 diabetes mellitus. Int J Biotechnol Biochem. 2018; 14 (2): 85-93.

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