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TSH Level In Type 2 Diabetes Mellitus Patients In Different Age Groups And The Effect Of Treatment

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ABSTRACT

Background:Type 2 diabetes mellitus (T2 DM) is frequently associated with thyroid dysfunction, particularly alterations in Thyroid Stimulating Hormone (TSH). Understanding the relationship between T2DM, age, and treatment on thyroid function is crucial for improving patient outcomes.
Objective: This study aimed to compare TSH levels between patients with T2DM and healthy controls, stratified by age groups, and to investigate the impact of different therapeutic regimens on thyroid function.
Methods: This is a cross sectional study, carried out during the period of December 2023 to February 2024.A total of (66) patients with T2DM and age -matched(33) healthy controls were enrolled. Participants were divided into three age groups (30–40, 40–50, and 50+ years). Serum TSH levels were measured using standard immunoassay methods. Statistical analysis included descriptive measures and independent t-tests for comparisons. Treatment-related differences were also analyzed.
Results:The results showed significantly higher mean TSH levels in diabetic patients compared to controls ($p = 0.031$). Age-stratified analysis revealed that patients over 50 years exhibited the highest TSH values, indicating an age-related exacerbation of thyroid dysfunction in T2DM. Regarding treatment effects, metformin-based therapy was associated with elevated TSH levels, while sulfonylureas showed variable responses and SGLT2 inhibitors demonstrated the lowest TSH levels, though sample size was limited. These findings underscore the intricate interactions among diabetes, thyroid function,age, and pharmacotherapy.
Conclusion: TSH levels in T2DM patients exhibit variability influenced by age and treatment, indicating the intricate relationship between diabetes and thyroid function. To get the best care for diabetic patients, especially older ones and those on certain treatment plans, it is important to check their thyroid status regularly.

Keywords: Diabetes mellitus type 2, TSH , dysfunction of thyroid , age groups, treatment effect , problems with metabolism.

I . INTRODUCTION

Type 2 diabetes mellitus (T2 DM) is a persistent metabolic disorder marked by insulin resistance, diminished insulin secretion, and escalating hyperglycemia. In addition to its traditional complications,

mounting evidence indicates a significant interaction between T2 DM and thyroid function . (1,2) Diabetes is becoming a bigger public health problem in Iraq .Most people don't know much about it, and people with type 2 diabetes mellitus who have a higher body mass index (BMI)have higher blood sugar

levels. Diabetic patients in Kirkuk have also had big changes in their blood, especially when they have other health problems, like intestinal parasites. (3-6)

Other studies have shown that pharmacologic treatments for people with long-term metabolic disorders can have a big effect on lipid and biochemical profiles .This, in turn, can affect how diabetes patients' metabolism works(7,8)

Thyroid- stimulating hormone (TSH) is a crucial regulator of thyroid function and metabolic equilibrium, with its variations commonly noted in individuals with diabetes. (9)Dysregulation of thyroid hormones in diabetic individuals may lead to metabolic instability, cardiovascular complications, and compromised glucose regulation. (10)

Age significantly influences the alteration of thyroid function and the advancement of diabetes .(1)Numerous studies indicate that TSH levels fluctuate across various age demographics , with older adults exhibiting a higher propensity for subclinical hypothyroidism or other thyroid dysfunctions ,(11)Understanding how TSH changes across age categories in diabetic patients provides valuable insight into the pathophysiology of endocrine, interactions and the risk of complications.(10)

The management of T2 DM , whether via oral hypoglycemic agents or insulin, may also impact thyroid function,(12)Certain therapies can directly or indirectly influence TSH secretion and metabolism, thereby complicating disease management,(13)Examining the effects of different treatment regimens on TSH levels may assist clinicians in customizing therapeutic strategies to enhance both glycemic and thyroid equilibrium.(14)

This study seeks to examine TSH levels in patients with type 2 diabetes mellitus across various age cohorts and to evaluate the impact of treatment, on thyroid function .The research aims to underscore the significance of integrated endocrine care in enhancing health outcomes, for diabetic patients through the analysis of these associations.

Ⅱ. MATERIALS AND METHODS

Study Population

This study comprised two cohorts : individuals with type 2 diabetes mellitus (T2 DM) and healthy control participants . The patient group comprised individuals clinically diagnosed with T2 DM,whereas the control group consisted of age- and sex-matched healthy individuals devoid of any history of diabetes or thyroid disease. There were three age groups for the participants : 30 to 40 years , 40 to 50 years, and 50 years and older.

1. Criteria for Inclusion and Exclusion

The study included patients with confirmed T2DM receiving medical treatment.

Exclusion criteria were : history of thyroid disease prior to diabetes diagnosis ,use of medications known to interfere with thyroid function(other than prescribed thyroxine), pregnancy, and severe systemic illnesses.

2. Data collection

For each participant, demographic data (age, sex), disease duration, and treatment regimen were recorded. The patient group was further classified based on the type of treatment received, including oral hypoglycemic agents, insulin therapy, or combined regimens.

3. Laboratory Measurements

Blood samples were taken after not eating throughout the night. Thyroid -stimulating hormone levels in the blood(TSH) were measured using a standard immunoassay method. For diabetic patients, additional clinical data including type and duration of therapy were documented.

4. Statistical Analysis

Participants were stratified into the three age groups for comparative analysis. Mean, and standard deviation(SD) of TSH values were calculated for each subgroup.An independent Student’s t- test was performed to compare TSH levels between patients and controls within each age category.A p -value < 0.05 was considered statistically significant.

Ⅲ. RESULT

All of the 66 patients diagnosed with type 2 diabetes mellitus and 33 healthy individuals were included in the statistical analysis .The mean age of the patient group was 47.68 ± 10.86 years , whereas the control group, had a mean age of 42.85 ± 9.98 years.

Regarding TSH levels, the mean serum TSH in the patient group was 3.14 ± 4.26 μIU/mL, compared to 1.91 ± 1.10 μIU/mL in the healthy controls. The independent t- test revealed astatistically significant difference($t = 2.20, p = 0.031$), indicating higher TSH levels in patients. The descriptive statistics for serum TSH levels in both of groups are summarized in table 1 :

Table 1. Descriptive statistics of TSH of the patient group and control group

Test	Patients (66) Mean± SD	Controls (33) Mean ±SD	P value
TSH(μIU /mL)	**3.14 ± 4.26**	**1.91 ± 1.10**	**S**

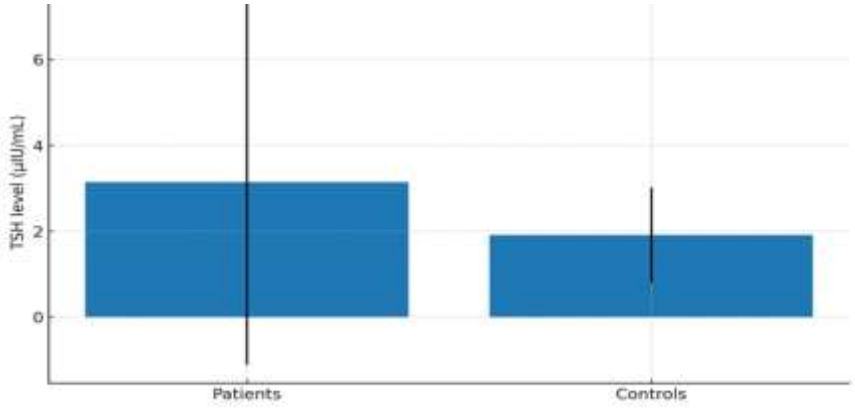

Figure 1: shows the mean serum TSH levels in patients and controls

Ⅲ. 1. Comparison of TSH Levels by Age Groups

Both patients and healthy controls were divided into three age categories:30 –39 years ,40–49 years ,and 50 years or older .The mean TSH levels within each age group were calculated and compared between the two groups. The descriptive statistics are summarized in Table 2 ,and the comparison is illustrated in Figure 2:

Table 2: Mean TSH levels across age groups

Age range Yrs	Patients TSH Mean±SD	Controls TSH Mean±SD	P value
30-40	2.61±2.46	1.55±0.83	S
40-50	1.79±1.19	2.53±0.92	S
50+	4.54±6.04	2.00±1.27	S

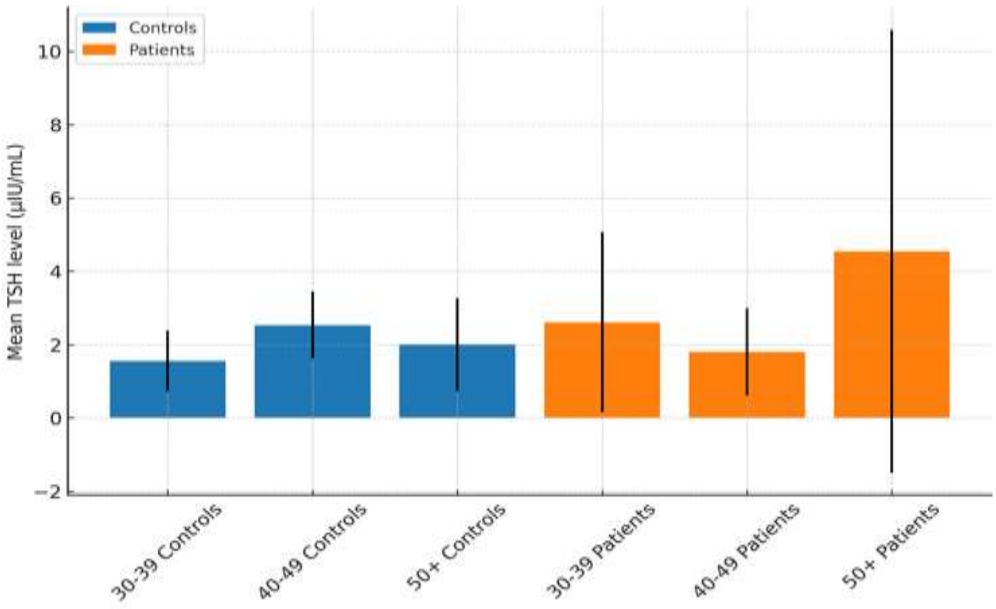

Figure 2: shows the mean TSH levels in patients and controls across the defined age groups

Ⅲ. 2. Comparison of TSH Levels by different treatments

The comparison of TSH levels across different treatment categories for type 2 diabetes mellitus patients reveals some notable patterns, Patients on Metformin-based therapy showed the highest mean TSH level (3.21 µIU/mL), with a relatively wide variability (SD = 2.07). While the Sulfonylureas group demonstrated a moderate mean TSH (2.47 µIU/mL), but with the largest variation (SD = 2.55) and the widest range (0.25–13.04). Whereas patients with no treatment or other treatments had a mean TSH level of 2.09 µIU/mL with lower variability (SD = 0.76). But the SGLT2 inhibitor (mono) group showed the lowest mean TSH (1.36 µIU/mL), although the sample size was very small (n=2), An analysis of variance (**ANOVA**) was performed to compare serum TSH levels among the four treatment groups (Metformin-based, SGLT2 inhibitor monotherapy, Sulfonylureas, and No treatment).

- **F-value:** 1.87
- **P- value :**0.147

As it shown in table3 and figure 3 :

Table 3: comparison of the effect of different treatments that patients use on their TSH level

Test	Metformin-based	SGLT2 inhibitor (mono)	Sulfonylureas	No treatment
TSH **(µIU/mL)**	3.21 2.07	1.36 1.49	2.47 2.55	2.09 0.76

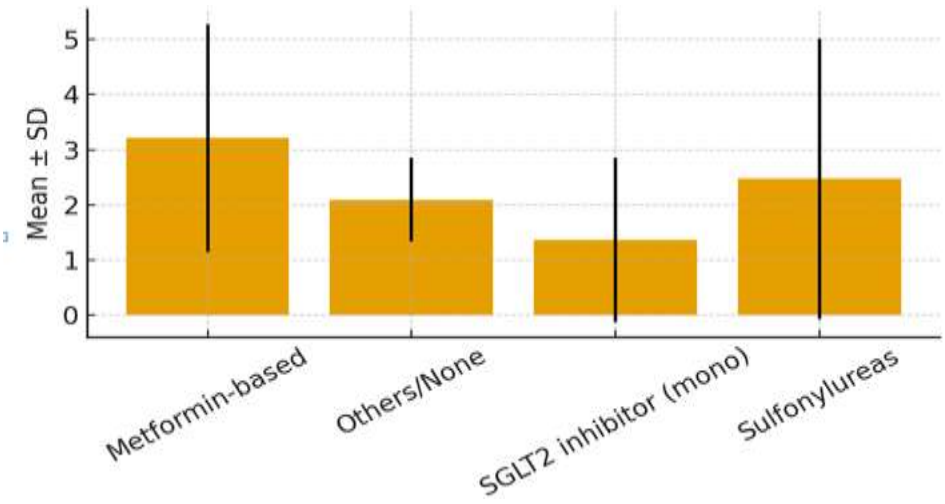

Figure 3: comparison of the effect of different treatments that patients use on their TSH level

Ⅳ. DISCUSSION

The present study investigated serum TSH levels in patients with type 2 diabetes mellitus(T2 DM)compared with healthy controls , while also assessing the influence of age distribution and antidiabetic treatments on thyroid function(15,16).

Our findings demonstrated significantly higher TSH levels in T2DM patients (3.14 ± 4.26 μIU/mL) compared to healthy individuals (1.91 ± 1.10 μIU/mL, p = 0.031). This result is consistent with previous studies which have reported an increased prevalence of subclinical hypothyroidism in diabetic populations (17,18). Several mechanisms may underlie this association, including insulin resistance, chronic low-grade inflammation, and altered hypothalamic-pituitary-thyroid axis regulation (19,20). When stratified by age, patients over 50 years exhibited the highest mean TSH values (4.54 ± 6.04 μIU/mL), whereas controls in the same age group had much lower levels (2.00 ± 1.27 μIU/mL). This suggests that advancing age may exacerbate thyroid dysfunction in diabetic patients (21,22)Similar findings were reported by Hage et al ,who noted that older diabetic patients were more prone to developing thyroid abnormalities, possibly due to longer disease duration, cumulative metabolic stress, and progressive beta-cell dysfunction(23).

In terms of pharmacological interventions, patients treated with metformin demonstrated the highest mean TSH levels (24). This is noteworthy, as metformin has been previously reported to modulate thyroid function, with some studies suggesting that it may reduce TSH levels in hypothyroid patients, while in euthyroid individuals the effect appears variable (25). The observed elevation in our study could reflect population-specific factors, disease severity, or treatment duration. Sulfonylureas, on the other hand, showed moderate TSH levels but with the greatest variability, which may indicate heterogeneous drug responses or underlying thyroid autoimmunity among certain patients(26).

Interestingly, patients treated with SGLT2 inhibitors had the lowest mean TSH levels, although the small sample size (n = 2) limits interpretation. There is currently limited evidence on the direct effects of SGLT2 inhibitors on thyroid function, but their favorable metabolic and cardiovascular effects could indirectly contribute to more stable thyroid hormone regulation (27) .further studies are wanted to clarify these observations .

Taken together ,these findings,highlight the complex interplay between diabetes, age, treatment regimens, and thyroid function. Screening for thyroid dysfunction in diabetic patients, particularly in older individuals and those on long-term treatment, is clinically relevant. Our results align with

recommendations from the American Diabetes Association (ADA), which emphasize periodic thyroid evaluation in diabetic populations(28).

More of the studies with largest sampl sizes and longitudinal designs ,are warranted to confirm the associations observed here and to elucidate the mechanisms linking T2DM, antidiabetic therapies, and thyroid dysfunction.

V. CONCLUSION

This study demonstrated that patients of type 2 diabetes mellitus exhibit significantly higher serum TSH levels compared to healthy controls, suggesting a close link between diabetes and thyroid dysfunction. The findings further indicate that advancing age is associated with greater alterations in TSH levels among diabetic individuals, emphasizing the importance of age-specific evaluation.

With regard to pharmacological interventions, metformin-based therapy was associated with elevated TSH levels, while sulfonylureas demonstrated wide variability in thyroid response. Although limited by small sample size, patients on SGLT2 inhibitors exhibited the lowest TSH levels, highlighting the need for further investigation into the impact of newer therapeutic agents on thyroid function. Since the P-value is a greater than 0.05 , the differences in TSH levels among the four medication groups are not statistically –significant . This indicates that, based on the available data, no treatment category showed a clear or consistent impact on TSH levels compared to the others.

Taken together, these results underscore the necessity of routine thyroid screening for diabetic patients , particularly in the older individuals so those undergoing long-term treatment. Integrating thyroid assessment into diabetes care may contribute to earlier detection of subclinical hypothyroidism, better metabolic control, and improved clinical outcomes. Future large-scale and longitudinal studies are Warranted to validate these associations and to explore ,the underlying mechanisms linking diabetes, thyroid function, and treatment effects.

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