RELATIONSHIP THYROID DYSFUNCTION AND PROTEINURIA IN PATIENTS WITH TYPE2 DIABETES WITH AND WITHOUT DIABETIC KIDNEY DISEASE

Maysara Mohamed Mogahed, Eman Mohamed Nageb El-Sayed, Amal Mohamed Saleh, and Yomna Mohamed Marei

Department of Internal Medicine, Faculty of Medicine, Benha University, Benha, Egypt

Corresponding author:
Amal Mohamed Saleh
Mobile: +2 201022843536
E-mail:
amalsaleh2555@gmail.com

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ABSTRACT:

Background: *Diabetic kidney disease (DKD) occurs in 25% to 40% of patients with diabetes mellitus (DM) and is the leading cause of kidney failure worldwide.*

Aim of the work: *To evaluate the association between proteinuria and degree of thyroid dysfunction in type II diabetes patients with and without diabetic nephropathy.*

Patients and Methods: *This prospective cross-sectional study was conducted on 104 patients with type II diabetes mellitus. Patients were allocated into 2 groups; group I (52 patients) included diabetic patients with diabetic kidney disease and group II (52 patients) included diabetic patients without diabetic kidney disease. All studied cases were subjected history taking, thorough clinical examination and laboratory investigations.*

Results*: TSH had the highest mean values among hyperfiltration group with statistically significant difference (p< 0.001). T3 had the lowest mean values among hyperfiltration group with statistically significant difference (p= 0.002). All hyperfiltration groups were hypothyroidism, 93% of hypofiltration were hypothyroidism and 78.1% of normal filtration were hypothyroidism showing presence of statistically significant difference as regard thyroid status (p= 0.04).*

Conclusion: *Hypothyroidism and diabetic kidney disease exhibit a bidirectional association, where each condition may exacerbate the progression of the other. This complex interplay significantly correlates with changes in proteinuria and estimated glomerular filtration rate, emphasizing the need for integrated management strategies in these patients.*

Keywords: *Thyroid Dysfunction; Proteinuria; Type2 Diabetes; Diabetic Kidney Disease.*

INTRODUCTION:

Diabetes mellitus (DM) is a prevalent chronic metabolic disorder associated with several severe complications, one of the most consequential being diabetic kidney disease (DKD). DKD affects 25% to 40% of patients with diabetes and is the primary cause of kidney failure globally [(1)]. Approximately 40% of individuals with diabetes will develop chronic kidney disease (CKD), which can progress to end-stage kidney disease (ESKD), necessitating kidney replacement therapy. This progression underscores the critical need for early identification of patients at high risk for progressive kidney function decline [(2)].

DKD is characterized by persistent albuminuria and a progressive decrease in renal function, driven by a complex interplay of hyperfiltration, mesangial expansion, and inflammatory processes that lead to structural and functional changes in the kidneys [3].

Thyroid dysfunction, which is more common in diabetic patients than in the general population, influences numerous metabolic processes including blood sugar regulation and insulin resistance. Thyroid hormones play vital roles in renal development, maintaining water and electrolyte balance, and modulating renal blood flow and tubular function [4&5].

Notably, thyroid dysfunction can exacerbate renal pathologies by affecting the renin-angiotensin system and altering renal hemodynamics. Furthermore, CKD itself can disrupt the synthesis of thyroid hormones by impacting the hypothalamus-pituitary-thyroid axis, creating a complex interdependency between thyroid function and renal health [6].

Recent studies have highlighted the potential impact of thyroid hormones on renal outcomes in non-diabetic CKD populations, where alterations in thyroid hormone levels, particularly low serum FT3, have been linked to endothelial dysfunction and could indirectly contribute to the progression of DKD in the presence of hyperglycemia. Moreover, proteinuria—a hallmark of kidney damage—can affect thyroid hormone levels by causing urinary losses of hormone-binding proteins, thereby complicating the assessment of renal and thyroid function [7].

Given the intricate relationship between thyroid function, diabetes, and renal health, there is a pressing need to explore how thyroid dysfunction influences proteinuria in diabetic patients, irrespective of the presence of overt nephropathy. Understanding this relationship could lead to better clinical strategies for managing both thyroid and kidney diseases in diabetic populations.

AIM OF THE WORK:

The aim of the current study is to evaluate the association between proteinuria and the degree of thyroid dysfunction in patients with type 2 diabetes, both with and without diabetic nephropathy.

PATIENTS AND METHODS:

A prospective, cross-sectional analysis was performed on 104 type II diabetes mellitus patients at the nephrology and endocrinology departments of Benha University Hospitals between April and September 2023. Each participant provided informed written consent and was given a confidential code number for privacy protection. Approval for this study was granted by the Faculty of Medicine's Research Ethics Committee at Benha University.

Eligibility Criteria:

Inclusion: Individuals diagnosed with type II diabetes mellitus, aged 18 years and above, from any gender.

Exclusion: Individuals diagnosed with liver disease, any form of cancer, pregnancy, or those suffering from end-stage renal disease.

Patient Grouping:

The participants were categorized into two groups: Group I comprised 52 patients with diabetic kidney disease, while Group II consisted of 52 patients without diabetic kidney disease.

Study Procedures:

Medical History Assessment: Gathered data included demographic details (age, sex), diabetes duration, treatment details, other diabetes-related complications, past renal conditions, and renal biopsy records.

Physical Examination: Emphasized the identification of thyroid dysfunction and other diabetes-related complications.

Screening for Diabetic Retinopathy: All study participants underwent fundus examinations to screen for diabetic retinopathy, performed by a qualified ophthalmologist using direct ophthalmoscopy. This screening was integral to the inclusion criteria for diagnosing diabetic kidney disease, ensuring that all patients met the necessary diagnostic thresholds for DKD as part of their initial evaluation.

Laboratory Evaluations: Measurements taken included fasting and 2-hour post-meal blood glucose, HbA1c levels, a complete blood count, thyroid function tests (free T3, free T4, and TSH), kidney function tests (serum creatinine, serum albumin), a full lipid profile (cholesterol, triglycerides, LDL, VLDL, HDL), urinalysis, and the albumin-to-creatinine ratio or a 24-hour urine protein test.

Sample Collection and Analysis: Blood samples were drawn after a minimum fasting period of 8 hours. Analytical procedures for assessing fasting glucose, creatinine, uric acid, cholesterol, triglycerides, HDL, and LDL levels utilized a uniform autoanalyzer. The HbA1c was quantified through high-performance liquid chromatography.

Serum levels of TSH, FT3, and FT4 were determined using a chemiluminescence immunoassay technique. The normal ranges for these tests were established as 0.38–4.34 mIU/L for TSH, 2.77–6.31 pmol/L for FT3, and 10.45–24.38 pmol/L for FT4. Urine albumin concentrations were assessed via an immunological turbidimetry technique, and urine creatinine concentrations were analyzed using the picric acid approach. From these measurements, the albumin/creatinine ratio (ACR) was computed. The estimated glomerular filtration rate (eGFR) was calculated employing the formula from the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI).

The American Diabetes Association criteria were utilized for diabetes diagnosis, which includes a fasting blood glucose level exceeding 126 mg/dL, a 2-hour blood glucose level of 200 mg/dL or higher, or an HbA1c of 6.5% or more.

The criteria for diagnosing DKD included persistent, severe albuminuria exceeding 300 mg per 24-hour urine collection (or over 200 μg/min), or an albumin-to-creatinine ratio exceeding 300 mg/g, verified in at least two out of three samples. This diagnosis also required the presence of diabetic retinopathy and the absence of indications of other renal pathologies.

Statistical analysis:

Data analysis was conducted using SPSS software, version 20.0, for Windows. The analysis included descriptive statistics such as mean values, standard deviations, medians, ranges, and percentages. For data adhering to a normal distribution, independent t-tests were utilized to assess the differences between means. Conversely, the Mann-Whitney U test was applied for comparing medians in datasets not following normal distribution. Categorical variables were analyzed using the chi-square test.

Ethical Considerations

The study started after the approval of the Research Ethical Committee with reference number (MS 18- 5- 2023), Faculty of Medicine, Benha University.

RESULTS:

Age, weight, body mass index and frequencies of hypertension, diabetic neuropathy, retinopathy, and diabetic foot were significantly higher in DKD patients than non- DKD patients ($P < 0.05$). There were no statistically significant differences between DKD and non- DKD groups as regard diabetes duration, treatment type, smoking and also ejection fraction. Table (1)

Table 1: Demographic data and Clinical condition differences between DKD and non- DKD patients

		DKD (n= 52)	Non- DKD (n= 52)	Test of significance	P value
Age (years)	Mean ± SD	56.9 ± 11.5	50.6 ± 10.02	t= 2.9	0.004
Sex No. (%)	Male Female	20 (38.5%) 32 (61.5%)	13 (25%) 39 (75%)	$X^2 = 2.2$	0.14
Weight (Kg)	Mean ± SD	99.3 ± 8.6	85.6 ± 9.3	t= 7.6	<0.001
Height (m)	Mean ± SD	1.63 ± 0.05	1.66 ± 0.05	t=-1.8	0.014
Body mass index (kg/m^2)	Mean ± SD	37.3 ± 4	31.02 ± 3.9	t= 8.1	<0.001
Diabetes duration (year)	Mean ± SD	6.13 ± 2.4	6.75 ± 2.01	t= -1.4	0.16
Treatment No. (%)	Oral Oral ± Insulin	50 (96.2%) 2 (3.8%)	51 (98.1%) 1 (1.9%)	X2 = 0.34	0.56
Smoking No. (%)	Mean ± SD	10 (19.2%)	13 (25%)	X2 = 0.5	0.48
Hypertension	Mean ± SD	46 (88.5%)	22 (42.3%)	X2 = 24.5	<0.001
Diabetic Neuropathy No. (%)	Mean ± SD	14 (26.9%)	1 (1.9%)	X2 = 13.2	<0.001
Diabetic Retinopathy No. (%)	Mean ± SD	38 (73.1%)	21 (40.4%)	X2 = 11.3	<0.001
Diabetic Foot No. (%)	Mean ± SD	12 (23.1%)	1 (1.9%)	X2 = 10.6	<0.001
Ejection fraction (%) No. (%)	<50 >50	15 (28.8%) 37 (71.2%)	12 (23.1%) 40 (76.9%)	X2 = 0.45	0.51

Laboratory investigations revealed that fasting blood glucose, HbA1c, cholesterol, triglycerides, and albumin/creatinine ratios were significantly higher in DKD patients compared to non-DKD patients ($P < 0.05$). Proteinuria was <30 g in all non-DKD patients but >300 g in most DKD patients, with a significant difference ($p < 0.001$). The mean eGFR was lower in the DKD group ($p = 0.04$), where 30.8% had hyperfiltration and 28.8% had hypofiltration, compared to normal rates in the non-DKD group ($p < 0.001$). Thyroid profiles showed more hypothyroidism and higher mean TSH levels, but lower T3 and T4 levels in DKD patients, all with statistically significant differences ($p \leq 0.007$). Table (2)

Table 2: Laboratory investigations of the studied groups

		DKD (n= 52)	Non- DKD (n= 52)	Test of significance	P value
Fasting blood sugar (mg/dL)	Mean ± SD	271.9 ± 39.4	157.1 ± 13.04	t= 19.9	<0.001
Haemoglobin A1c (%)	Mean ± SD	7.6 ± 0.7	7.3 ± 0.9	t= 1.9	0.04
Thyroid status No. (%)	Hypothyroidism Hyperthyroidism	48 (92.3%) 4 (7.7%)	39 (75%) 13 (25%)	X2 = 5.7	0.007
Thyroid duration (year)	Mean ± SD	5.5 ± 2.8	4.8 ± 1.3	t= 1.54	0.13
TSH (uIU/mL)	Mean ± SD	12.2 ± 4.5	8.13 ± 4	t= 4.4	<0.001
Free T3 (ng/dL)	Mean ± SD	51.1 ± 22.2	107.1 ± 15.6	t= -3.4	<0.001
Free T4 (ug/dL)	Mean ± SD	2.03 ± 1.05	3.47 ± 0.3	t= -3.8	<0.001
Cholesterol (mg/dL)	Mean ± SD	365.3 ± 80.7	255.2 ± 77.9	t= 9.01	<0.001
Triglycerides (mg/dL)	Mean ± SD	199.54 ± 9.2	142.2 ± 7.5	t= 4.8	<0.001
Albumin/ creatinine ratio	Mean ± SD	813.8 ± 374	20.3 ± 4.3	t= 15.3	<0.001
Proteinuria No. (%)	<30 30- 300 >300	0 (0%) 13 (25%) 39 (75%)	52 (100%) 0 (0%) 0 (0%)	X2 = 104	<0.001
eGFR (ml/min/m^2)	Mean ± SD	82.4 ± 41.2	96.7 ± 7.7	t= -2.1	0.04
eGFR	Hypofiltration Normal Hyperfiltration	15 (28.8%) 21 (40.4%) 16 (30.8%)	0 (0%) 52 (100%) 0 (0%)	X2 = 44.2	<0.001

FBS: Fasting blood sugar, TSH: Thyroid stimulating hormone, eGFR: estimated Glomerular filtration rate. Free T3: triiodothyronine, Free T4: thyroxine.

The multivariate regression analysis showed that body mass index, hypothyroidism, TSH, cholesterol and incidence of microvascular complications as diabetic retinopathy kept their significance as predictors for incidence of diabetic kidney disease. Additionally, fasting blood glucose, A1c, hypothyroidism, T3, T4, TSH, eGFR and microvascular complications as diabetic retinopathy were considered statistically significant predictors for proteinuria. Table (3).

Table 3: Multivariate analysis of predictors for incidence of diabetic kidney disease and predictors of proteinuria

	B estimate	95% confidence interval		Odds ratio	P value
		Lower	Upper		
Predictors for incidence of diabetic kidney disease					
Age	-0.09	0.82	1.009	1.1	0.07
Body mass index	-0.8	0.27	0.71	2.2	<0.001
Hypothyroidism	10.9	6.5	50.8	1.74	0.002
T3	0.015	0.99	1.036	0.9	0.13
T4	0.5	0.47	5.8	0.6	0.43
TSH	-0.4	0.47	0.9	1.5	0.018
Cholesterol	0.07	1.039	1.13	1.08	<0.001
Microvascular complications (retinopathy)	9.4	3.4	6.8	1.8	0.003
Macrovascular complications (Diabetic foot)	6.7	1.3	5.6	1.3	0.07
Predictors of proteinuria					
Age	3.13	-0.01	6.28	1.98	0.06
Body mass index	0.089	-7.3	7.5	0.02	0.98
Fasting blood glucose	3.96	2.9	5.01	7.5	<0.001
HbA1c	18.5	138.5	233	7.8	<0.001
Cholesterol	0.75	-0.14	1.6	1.67	0.09
Hypothyroidism	-16.6	-19.34	-13.9	-12.16	<0.001
T3	1.16	0.41	1.92	3.06	0.003
T4	-252.8	-302.5	-203.2	-10.1	<0.001
TSH	56.6	45.1	67.9	9.8	<0.001
Estimate glomerular filtration	1.9	0.86	3.13	3.5	<0.001
Microvascular complications (retinopathy)	-189.02	-292.3	-85.79	-3.6	<0.001
Macrovascular complications (Diabetic foot)	19.04	-51.1	89.19	0.5	0.6

Free T3: triiodothyronine, Free T4: thyroxine, TSH: thyroid stimulating hormone.

The A3 group showed the highest mean TSH levels and the lowest mean T3 and T4 levels, all with statistically significant differences ($p < 0.001$). Hypothyroidism was prevalent in all A3 patients, compared to lower rates in A1 and A2 groups. Similarly, the hyperfiltration group recorded the highest mean TSH and the lowest mean T3 levels, with significant differences ($p < 0.001$ and $p = 0.002$, respectively). Hypothyroidism was more common in the hyperfiltration group (100%), compared to hypofiltration (93%) and normal filtration groups (78.1%), showing significant differences in thyroid status ($p = 0.04$).

In the total cohort, significant positive correlations were observed between the albumin/creatinine ratio and age, BMI, fasting glucose, HbA1c, cholesterol, triglycerides, TSH, and eGFR, with inverse correlations to T3 and T4. No significant correlations were found with the duration of diabetes or thyroid disease. A notable positive correlation was found between eGFR and TSH in diabetic patients ($r: 0.58$; $p < 0.001$), but not with other factors like age, BMI, or cholesterol. Table (4)

Table 4: Association between thyroid function tests, proteinuria and eGFR in total cohort

		Proteinuria			P value
		A1 (pro < 30) (non- DKD) (n=52)	A2 (pro-30- 300) DKD (n=13)	A3 (pro >300) DKD (n=39)	
TSH (uIU/mL)	Mean ± SD	8.13 ± 4.1	6.26 ± 3.1	14.2 ± 2.8 a, b	<0.001
Free T3 (ng/dL)	Mean ± SD	107.1 ± 15.7	74.23 ± 15.5	43.4 ± 12.8 a	<0.001
Free T4 (ug/dL)	Mean ± SD	3.5 ± 0.4	3.15 ± 0.7	1.7 ± 0.12 a, b	<0.001
Thyroid status No. (%)	Hypothyroidism Hyperthyroidism	39 (75%) 13 (25%)	9 (69.2%) 4 (30.8%)	39 (100%) 0 (0%)	0.004
		eGFR			P value
		Hypofiltration (n= 15)	Normal filtration (n= 73)	Hyperfiltration (n= 16)	
TSH (uIU/mL)	Mean ± SD	10.3 ± 4.6	8.9 ± 4.3	15.9 ± 3.3 a, b	<0.001
Free T3 (ng/dL)	Mean ± SD	71.7 ± 13.5	88.4 ± 11.7	43.5 ± 4.7 a, b	0.002
Free T4 (ug/dL)	Mean ± SD	1.9 ± 0.5	3.05 ± 1.2	2.2 ± 0.9	0.06
Thyroid status No. (%)	Hypothyroidism Hyperthyroidism	14 (93.3%) 1 (6.7%)	57 (78.1%) 16 (21.9%)	16 (100%) 0 (0%)	0.04

Free T3: triiodothyronine, Free T4: thyroxine, TSH: thyroid stimulating hormone.

Significant correlations were observed between age and TSH (r: 0.24; p= 0.015), with inverse correlations between age and both T3 (r: -0.24; p= 0.012) and T4 (r: -0.22; p= 0.024). BMI showed a positive correlation with TSH (r: 0.44; p < 0.001) and negative correlations with T3 (r: -0.25; p= 0.008) and T4 (r: -0.29; p= 0.002). Fasting blood sugar (FBS) correlated positively with TSH (r: 0.3; p= 0.001) and negatively with T3 (r: -0.29; p= 0.002) and T4 (r: -0.3; p= 0.001). Cholesterol levels showed a strong positive correlation with TSH (r: 0.8; p < 0.001) and strong inverse correlations with T3 (r: -0.74; p < 0.001) and T4 (r: -0.76; p < 0.001). No significant correlations were found between TSH, T3, T4, and HbA1c, diabetes duration, or thyroid disease duration. Table (5).

Table 5: Correlation analysis of TSH, T3 and T4 to other factors than eGFR and albumin/ creatinine ratio

	TSH		T3		T4	
	Pearson correlation (r)	P value	Pearson correlation (r)	P value	Pearson correlation (r)	P value
Age	0.24	0.015	-0.24	0.012	-0.22	0.024
Body mass index	0.44	<0.001	-0.25	0.008	-0.29	0.002
Fasting blood glucose	0.3	0.001	-0.29	0.002	-0.3	0.001
Hemoglobin HbA1c	0.12	0.1	-0.052	0.61	0.13	0.19
Diabetes duration	0.14	0.13	0.18	0.09	0.16	0.11
Cholesterol	0.8	<0.001	-0.74	<0.001	-0.76	<0.001
Thyroid disease duration	0.028	0.78	-0.17	0.09	-0.12	0.24

Free T3: triiodothyronine, Free T4: thyroxine, TSH: thyroid stimulating hormone, eGFR: estimated glomerular filtration rate.

DISCUSSION:

This study assessed the relationship between proteinuria and thyroid dysfunction in type II diabetes patients with and without DKD. All participants had thyroid diseases, with hypothyroidism being more prevalent in DKD patients and hyperthyroidism more common in non-DKD patients, supported by findings from *Peters et al.* [8]. TSH levels were higher and T3 and T4 levels were lower in DKD compared to non-DKD patients, similar to results from *Zhao et al.* [9].

Additionally, DKD patients showed significantly higher albumin/creatinine ratios and varied degrees of proteinuria, aligning with findings by Stefanowicz-*Rutkowska et al.* [10]. eGFR levels were also significantly lower in DKD patients, consistent with *Zhao et al.* [9]. Multivariate logistic regression identified hypothyroidism and elevated TSH as significant predictors of DKD, corroborated by *Liu et al.* [11].

Furthermore, the study found that patients with more severe proteinuria (A3) had higher TSH and lower T3 and T4 levels compared to those with less severe conditions (A1 and A2), a finding also reported by *Liu et al.* [11].

In this study, significant positive correlations were found between proteinuria and TSH levels across all patients and specifically in the DKD group, supported by *Wang et al.* [12] but contradicted by *Shi et al.* [13], who noted no such correlation in DKD patients with compromised eGFR. Conversely, free T3 and T4 showed significant inverse correlations with proteinuria, a finding echoed by *Zhao et al.* [9].

Additionally, proteinuria positively correlated with patients' age and BMI, findings supported by *Shi et al.* [13] and *Wang et al.* [12], respectively. However, *Nsr-Allah et al.* [14] observed no significant correlation between age or BMI and proteinuria in diabetic patients.

Further, significant positive correlations were noted between fasting blood glucose, A1c, and proteinuria, corroborated by *Shi et al.* [13] for A1c. In contrast, *Wang et al.* [12] found no correlation between A1c and proteinuria. Proteinuria also correlated positively with diabetes duration in DKD patients, a correlation that extended to lipid profiles, specifically cholesterol and triglycerides.

Lastly, a significant positive correlation between eGFR and proteinuria was observed in both total cohort and DKD patients, supported by *Zhao et al.* [15]. *Nsr-Allah et al.* [14], however, reported an inverse association, likely influenced by the inclusion of patients with severe eGFR impairment.

In this study, TSH levels were highest in the hyperfiltration group, with statistically significant differences noted ($p < 0.001$), while T3 levels were lowest in the same group ($p = 0.002$). A high prevalence of hypothyroidism was observed across all filtration groups, especially in those with impaired filtration rates. Supporting these findings, *Tanaka et al.* [16] and *Griffin and Griffin* [17] noted a correlation between eGFR and TSH, particularly linking hyperfiltration with hypothyroidism.

Moreover, eGFR showed a positive correlation with TSH across all study participants, including DKD patients. This finding was corroborated by *Tanaka et al.* [16], although *Shi et al.* [13] and *Iwakura et al.* [18] reported no significant correlation and even inverse correlations, respectively.

Regarding T3 and T4, no significant correlations with eGFR were found in this study, contrary to the findings of *Liu et al.* [11] and *Shi et al.* [13], suggesting variability possibly due to different methodologies or sample sizes.

TSH also positively correlated with patient age and BMI, while T3 and T4

inversely correlated with these parameters. This was in line with findings from *Iwakura et al.*[18] for age and *Zhang et al.*[19] for BMI, although *Tanaka et al.*[16] found no significant association between TSH and BMI in DKD patients.

In this study, TSH positively correlated with FBS and cholesterol, while T3 and T4 inversely correlated with these parameters. *Han et al.*[20] confirmed the significant correlation of thyroid hormones with FBS, whereas *Tanaka et al.*[16] found no such association among DKD patients. Similarly, *Zhang et al.*[19] observed a significant correlation between thyroid hormones and cholesterol levels, contrasting with *Han et al.*[20], who found no significant correlation with cholesterol in diabetic patients. Additionally, no significant correlations were found between TSH, T3, T4, and either hemoglobin A1c or diabetes duration. While *Han et al.*[20] reported similar findings, *Iwakura et al.*[18] noted that T3 and T4 inversely correlated with hemoglobin A1c and diabetes duration.

Conclusion:

Hypothyroidism and diabetic kidney disease had cause- effect relationship or significant association. This association is bi-directional as hypothyroidism plays an important role in kidney disease progression among diabetic kidney disease patients. Also, progression of kidney disease affects thyroid hormone clearance. Proteinuria and estimated glomerular filtration rate correlated significantly to thyroid hormones. Beside thyroid status (hypothyroidism), body mass index, cholesterol and microvascular diabetic complications were considered significant predictors for incidence of diabetic kidney disease patients.

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No conflicts of interest

REFERENCES :

1. **DeFronzo RA and Bakris GL**. Modifying chronic kidney disease progression with the mineralocorticoid receptor antagonist finerenone in patients with type 2 diabetes. Diabetes, Obesity and Metabolism. 2022;24(7):1197-205.
2. **Kreiner FF, Kraaijenhof JM, von Herrath M, Hovingh GKK and von Scholten BJ**. Interleukin 6 in diabetes, chronic kidney disease, and cardiovascular disease: mechanisms and therapeutic perspectives. Expert Review of Clinical Immunology. 2022;18(4):377-89.
3. **Jung C-Y and Yoo T-H**. Pathophysiologic mechanisms and potential biomarkers in diabetic kidney disease. Diabetes & Metabolism Journal. 2022;46(2):181-97.
4. **Li L-R, Song J-L, Liu H-Q and Chen C**. Metabolic syndrome and thyroid Cancer: risk, prognosis, and mechanism. Discover Oncology. 2023;14(1):23.

5. **Braga PC, Alves MG, Rodrigues AS and Oliveira PF**. Mitochondrial pathophysiology on chronic kidney disease. International Journal of Molecular Sciences. 2022;23(3):1776.

6. **Galton VA and Hernandez A**. Thyroid hormone metabolism: A historical perspective. Thyroid. 2023;33(1):24-31.

7. **You AS, Budoff M, Zeb I, Ahmadi N, Novoa A, Flores F, et al.** Elevated serum thyrotropin levels and endothelial dysfunction in a prospective hemodialysis cohort. Hemodialysis International. 2022;26(1):57-65.

8. **Peters KE, Chubb SAP, Bruce DG, Davis WA and Davis TME**. Prevalence and incidence of thyroid dysfunction in type 1 diabetes, type 2 diabetes and latent autoimmune diabetes of adults: The Fremantle Diabetes Study Phase II. Clin Endocrinol (Oxf). 2020;92(4):373-82.

9. **Zhao W, Li X, Liu X, Lu L and Gao Z**. Thyroid Function in Patients with Type 2 Diabetes Mellitus and Diabetic Nephropathy: A Single Center Study. J Thyroid Res. 2018;2018:9507028.

10. **Stefanowicz-Rutkowska MM, Matuszewski W, Gontarz-Nowak K and Bandurska-Stankiewicz EM**. Is there a relationship between the prevalence of autoimmune thyroid disease and diabetic kidney disease? Open Life Sci. 2021;16(1):611-9.

11. **Liu MC, Li JL, Wang YF, Meng Y, Cai Z, Shen C, et al.** Association between thyroid hormones and diabetic kidney disease in Chinese adults. BMC Endocr Disord. 2023;23(1):56.

12. **Wang J, Li H, Tan M, Gao G, Zhang Y, Ding B, et al.** Association between thyroid function and diabetic nephropathy in euthyroid subjects with type 2 diabetes mellitus: a cross-sectional study in China. Oncotarget. 2019;10(2):88-97.

13. **Shi W, Song D, Chen D, Duan W and Zhang J**. The association of thyroid parameters with markers of chronic kidney disease in euthyroid patients with type 2 diabetes. Endocr J. 2023;70(7):687-96.

14. **Nsr-Allah AA-EM, Fatah AHA-E, Azab M and Fawzi MM**. Association between subclinical hypothyroidism and diabetic nephropathy in type 2 diabetes. The Egyptian Journal of Internal Medicine. 2018;30(3):160-7.

15. **Zhao X, Sun J, Xin S and Zhang X**. Predictive Effects of FT3/FT4 on Diabetic Kidney Disease: An Exploratory Study on Hospitalized Euthyroid Patients with T2DM in China. Biomedicines. 2023;11(8):45-53.

16. **Tanaka Y, Furusyo N, Kato Y, Ueyama T, Yamasaki S, Ikezaki H, et al.** Correlation between Thyroid Stimulating Hormone and Renal Function in Euthyroid Residents of Japan: Results from the Kyushu and Okinawa Population Study (KOPS). J Atheroscler Thromb. 2018;25(4):335-43.

17. **Griffin TP and Griffin MD**. Thyroid Dysfunction and Chronic Kidney Disease: Unravelling the Connection. Mayo Clin Proc. 2024;99(1):7-9.

18. **Iwakura H, Takagi T, Inaba H, Doi A, Ueda Y, Uraki S, et al.** Thyroid function, glycemic control, and diabetic nephropathy in patients with type 2 diabetes over 24 months: prospective observational study. BMC Endocr Disord. 2023;23(1):146.

19. **Zhang Y, Wang Y, Tao XJ, Li Q, Li FF, Lee KO, et al.** Relationship between Thyroid Function and Kidney Function in Patients with Type 2 Diabetes. Int J Endocrinol. 2018;2018:1871530.

20. **Han Q, Zhang J, Wang Y, Li H, Zhang R, Guo R, et al.** Thyroid hormones and diabetic nephropathy: An essential relationship to recognize. Nephrology (Carlton). 2019;24(2):160-9.

علاقة وظائف الغدة الدرقية بنسبة الزلال في البول بين مرضى السكر من النوع الثاني مع أو بدون الإصابة بمرض الكلى السكري

ميسرة محمد مجاهد ، إيمان محمد نجيب السيد ، أمل محمد صالح ، ويمنى محمد مرعي

قسم الباطنه العامه، كلية الطب، جامعة بنها، بنها، مصر

الخلفية: تحدث أمراض الكلى الناتجة عن السكري في نسبة تتراوح بين 25% إلى 40% من مرضى داء السكري وتعتبر السبب الرئيسي لفشل الكلى على مستوى العالم.

هدف الدراسة: تقييم العلاقة بين بروتينية البول ودرجة اختلال وظائف الغدة الدرقية في مرضى السكري من النوع الثاني مع وبدون اعتلال الكلى الناتج عن السكري.

المرضى والطرق: تم إجراء هذه الدراسة الاستقطاعية المستقبلية على 104 مرضى مصابين بداء السكري من النوع الثاني. تم تقسيم المرضى إلى مجموعتين؛ المجموعة الأولى (52 مريضاً) تضمنت مرضى السكري المصابين بأمراض الكلى الناتجة عن السكري، والمجموعة الثانية (52 مريضاً) تضمنت مرضى السكري الذين لا يعانون من اعتلال الكلى. تم إخضاع جميع الحالات المدروسة لأخذ التاريخ المرضي، والفحص السريري الشامل، والتحقيقات المخبرية.

النتائج: سجل هرمون تحفيز الغدة الدرقية أعلى القيم المتوسطة بين مجموعة الفلترة الزائدة مع وجود فرق ذو دلالة إحصائية. سجل هرمون الثيروكسين الثلاثي أدنى القيم المتوسطة بين مجموعة الفلترة الزائدة مع وجود فرق ذو دلالة إحصائية. كانت جميع مجموعات الفلترة الزائدة تعاني من قصور الغدة الدرقية، 93% من مجموعة الفلترة القليلة كانت تعاني من قصور الغدة الدرقية و78.1% من مجموعة الفلترة الطبيعية كانت تعاني من قصور الغدة الدرقية مما يظهر وجود فرق ذو دلالة إحصائية في الحالة الدرقية.

الخلاصة: يوجد علاقة سببية أو ارتباط معتبر بين قصور الغدة الدرقية وأمراض الكلى الناتجة عن السكري. هذا الارتباط ثنائي الاتجاه حيث يلعب قصور الغدة الدرقية دورًا هامًا في تقدم مرض الكلى بين مرضى أمراض الكلى الناتجة عن السكري. كما يؤثر تقدم مرض الكلى على إزالة هرمونات الغدة الدرقية. وقد وُجد ارتباط معتبر بين بروتينية البول ومعدل الترشيح الكبيبي المقدر وهرمونات الغدة الدرقية.