

THYROID DYSFUNCTION IN CHRONIC KIDNEY DISEASE: A CROSS-SECTIONAL STUDY ASSESSING PREVALENCE AND ASSOCIATION WITH DISEASE SEVERITY.

Endocrinology

Dr V Naga Datta
Dinesh

Dr Hanuma
Kumar MD

ABSTRACT

Background: Thyroid dysfunction is a common but often underrecognized comorbidity in chronic kidney disease (CKD), with a complex bidirectional relationship affecting both systems. **Objective:** To evaluate the prevalence and pattern of thyroid dysfunction in CKD patients and assess its association with the severity of renal impairment. **Methods:** This hospital-based cross-sectional study included 50 CKD patients attending General Medicine OPD/IPD over six months. Renal parameters (serum creatinine, blood urea, eGFR) and thyroid profile (T3, T4, FT3, FT4, TSH) were analyzed. CKD staging was done as per KDIGO guidelines. Statistical analysis included chi-square test and correlation analysis. **Results:** Thyroid dysfunction was observed in 76.0% of patients, with low T3 syndrome being the most common abnormality (36.0%), followed by subclinical (26.0%) and overt hypothyroidism (14.0%). A significant association was found between CKD stage and thyroid dysfunction ($p = 0.031$), with higher prevalence in advanced stages. Serum creatinine and blood urea showed negative correlation with FT3 and FT4, and positive correlation with TSH, while eGFR demonstrated the opposite trend ($p < 0.05$). **Conclusion:** Thyroid dysfunction is highly prevalent in CKD and significantly associated with disease severity. Routine thyroid function assessment may aid in early detection and improved clinical management.

KEYWORDS

Chronic Kidney Disease, Thyroid Dysfunction, Low T3 Syndrome, Estimated Glomerular Filtration Rate.

INTRODUCTION

Chronic kidney disease (CKD) is a progressive and irreversible decline in renal function that represents a major global health burden, contributing significantly to morbidity, mortality, and healthcare costs. The prevalence of CKD has increased worldwide due to the rising incidence of diabetes, hypertension, and aging populations, making early identification of associated systemic complications essential for optimal patient management [1,2]. Among these, endocrine disturbances—particularly thyroid dysfunction—are increasingly recognized as important yet underdiagnosed comorbidities in CKD patients.

The physiological relationship between the thyroid gland and kidneys is complex and bidirectional. Thyroid hormones play a crucial role in renal development, regulation of renal blood flow, glomerular filtration rate (GFR), and maintenance of water and electrolyte balance. Conversely, the kidneys are involved in the metabolism, degradation, and excretion of thyroid hormones and iodine [3,4]. In CKD, impaired renal function leads to multiple alterations in thyroid physiology, including reduced peripheral conversion of thyroxine (T4) to triiodothyronine (T3), accumulation of inflammatory cytokines, metabolic acidosis, and retention of iodide, all of which contribute to altered thyroid hormone levels [5,6].

The most commonly observed thyroid abnormality in CKD is low T3 syndrome, followed by subclinical hypothyroidism and, less frequently, overt hypothyroidism. Several studies have demonstrated a high prevalence of thyroid dysfunction in CKD patients, ranging from 13% in early stages to as high as 70% in end-stage renal disease [7,8]. Notably, recent large-scale population-based studies have identified subclinical hypothyroidism as an independent risk factor for CKD, suggesting a potential role of thyroid dysfunction not only as a consequence but also as a contributor to renal disease progression [9].

Furthermore, emerging evidence indicates that the severity of thyroid dysfunction correlates with the progression of CKD, with declining GFR associated with worsening thyroid hormone abnormalities, particularly reductions in serum T3 levels [6,10]. Despite these observations, thyroid dysfunction often remains clinically silent in CKD patients, leading to underdiagnosis and missed opportunities for early intervention.

In this context, the present study aims to evaluate the prevalence of thyroid dysfunction in patients with chronic kidney disease and to assess its relationship with the severity of renal impairment.

Aim

To study the prevalence and pattern of thyroid dysfunction in patients with chronic kidney disease and its association with the severity of renal impairment.

Objectives

1. To determine the prevalence of thyroid dysfunction among patients with chronic kidney disease.
2. To identify the pattern of thyroid abnormalities in chronic kidney disease patients using thyroid hormone parameters.
3. To study the association between thyroid dysfunction and severity of chronic kidney disease as assessed by serum creatinine, blood urea, and estimated glomerular filtration rate.
4. To compare thyroid hormone parameters across different stages of chronic kidney disease.
5. To identify the most common thyroid abnormality in the study population.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based cross-sectional observational study conducted in the Department of General Medicine at Santhiram Medical College and General Hospital, Nandyal, a tertiary care teaching hospital.

Study Duration

The study was carried out over a period of six months, from April 2026 to September 2026.

Study Population

The study included patients diagnosed with chronic kidney disease (CKD) attending the inpatient and outpatient departments of General Medicine during the study period.

Sample Size

A total of 50 patients fulfilling the inclusion and exclusion criteria were enrolled.

Sampling Technique

Patients were selected using simple random sampling from eligible CKD cases.

Inclusion Criteria

1. Patients aged ≥ 18 years
2. Patients diagnosed with chronic kidney disease (CKD)
3. Patients on conservative management
4. Both male and female patients

Exclusion Criteria

1. Patients on hemodialysis or peritoneal dialysis
2. Patients with known thyroid disorders
3. Patients on medications affecting thyroid function (amiodarone, steroids, phenytoin, beta-blockers, estrogen therapy, iodine-containing drugs)
4. Patients with acute illness, recent surgery, or trauma
5. Patients with significant hypoalbuminemia

Definition of Chronic Kidney Disease

CKD was defined according to KDIGO guidelines as:

- Kidney damage for ≥ 3 months, evidenced by markers such as:
 - Albuminuria (albumin-creatinine ratio ≥ 30 mg/g), or
 - Structural abnormalities
- OR
- eGFR < 60 mL/min/1.73 m² for ≥ 3 months, irrespective of cause

Staging of CKD

CKD was classified based on estimated glomerular filtration rate (eGFR) into:

Stage	eGFR (mL/min/1.73 m ²)
Stage 1	≥ 90 (with evidence of kidney damage)
Stage 2	60–89 (with evidence of kidney damage)
Stage 3	30–59
Stage 4	15–29
Stage 5	< 15

Note: Patients in Stage 1 and 2 were included only if evidence of kidney damage (e.g., albuminuria or structural abnormality) was present.

Data Collection Procedure

After obtaining Institutional Ethics Committee approval and written informed consent, eligible patients were enrolled. Demographic details, clinical history, and relevant findings were recorded using a structured proforma.

Laboratory Investigations

Renal Parameters

- Serum creatinine
- Blood urea nitrogen
- Estimated glomerular filtration rate (eGFR)
- Urine albumin-creatinine ratio (for CKD staging 1 & 2 confirmation)

Thyroid Profile

- Total triiodothyronine (T3)
- Total thyroxine (T4)
- Free triiodothyronine (FT3)
- Free thyroxine (FT4)
- Thyroid stimulating hormone (TSH)

Classification of Thyroid Dysfunction

Based on thyroid function tests:

- Euthyroid
- Low T3 syndrome (low T3/FT3 with normal TSH)
- Subclinical hypothyroidism (elevated TSH with normal FT4)
- Overt hypothyroidism (elevated TSH with low FT4)

Outcome Measures

- Prevalence of thyroid dysfunction in CKD patients
- Distribution of thyroid abnormalities across CKD stages (1–5)
- Association between thyroid profile and renal parameters

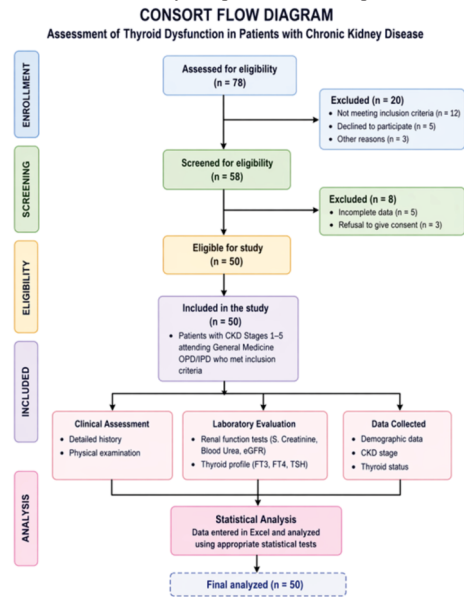


Figure 1. Consort Flow Diagram

Statistical Analysis

Continuous variables were expressed as mean $\pm$ standard deviation (SD). Categorical variables were expressed as frequency and percentage. Chi-square test was used to assess association between CKD stages and thyroid dysfunction. Correlation analysis (Pearson/Spearman) was used for relationship between eGFR and thyroid hormones. p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants. Confidentiality was maintained throughout the study.

RESULTS

Table 1: Baseline Characteristics of the Study Population (N = 50)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	4	8.0
	31–40	8	16.0
	41–50	12	24.0
	51–60	15	30.0
	> 60	11	22.0
Gender	Male	31	62.0
	Female	19	38.0
CKD Stage	Stage 1	3	6.0
	Stage 2	5	10.0
	Stage 3	14	28.0
	Stage 4	13	26.0
	Stage 5	15	30.0
Serum Creatinine (mg/dL)	Mean $\pm$ SD	4.21 $\pm$ 2.36	
Blood Urea (mg/dL)	Mean $\pm$ SD	96.40 $\pm$ 38.75	
eGFR (mL/min/1.73 m ²)	Mean $\pm$ SD	31.82 $\pm$ 24.16	

A total of 50 patients with chronic kidney disease were included in the study. The majority of patients belonged to the 51–60 years age group (30.0%), followed by 41–50 years (24.0%), > 60 years (22.0%), 31–40 years (16.0%), and 18–30 years (8.0%). Males constituted 62.0% (n = 31) of the study population, while females accounted for 38.0% (n = 19). The distribution of CKD stages showed that 6.0% (n = 3) were in stage 1, 10.0% (n = 5) in stage 2, 28.0% (n = 14) in stage 3, 26.0% (n = 13) in stage 4, and 30.0% (n = 15) in stage 5. The mean serum creatinine was 4.21 ± 2.36 mg/dL, mean blood urea was 96.40 ± 38.75 mg/dL, and mean eGFR was 31.82 ± 24.16 mL/min/1.73 m².

Table 2: Thyroid Profile Distribution in Study Population (N = 50)

Thyroid Status	Frequency (n)	Percentage (%)
Euthyroid	12	24.0
Low T3 Syndrome	18	36.0
Subclinical Hypothyroidism	13	26.0
Overt Hypothyroidism	7	14.0
Total	50	100.0

With regard to thyroid status, 24.0% (n = 12) of patients were euthyroid, while 76.0% (n = 38) exhibited thyroid dysfunction. Low T3 syndrome was the most frequent abnormality, observed in 36.0% (n = 18) of patients, followed by subclinical hypothyroidism in 26.0% (n = 13) and overt hypothyroidism in 14.0% (n = 7).

Table 3: Association Between CKD Stage and Thyroid Dysfunction (N = 50)

CKD Stage	Eu-thyroid	Low T3 Syndrome	Subclinical Hypo-thyroidism	Overt Hypo-thyroidism	Total	$\chi^2 = 13.8$, p = 0.031
Stage 1	2	1	0	0	3	
Stage 2	2	2	1	0	5	
Stage 3	5	5	3	1	14	
Stage 4	2	5	4	2	13	
Stage 5	1	5	5	4	15	
Total	12	18	13	7	50	

When analyzed across CKD stages, stage 1 included 2 euthyroid patients and 1 with low T3 syndrome. In stage 2, 2 patients were euthyroid, 2 had low T3 syndrome, and 1 had subclinical hypothyroidism. In stage 3, 5 patients were euthyroid, 5 had low T3 syndrome, 3 had subclinical hypothyroidism, and 1 had overt hypothyroidism. In stage 4, 2 patients were euthyroid, 5 had low T3

syndrome, 4 had subclinical hypothyroidism, and 2 had overt hypothyroidism. In stage 5, 1 patient was euthyroid, while 5 had low T3 syndrome, 5 had subclinical hypothyroidism, and 4 had overt hypothyroidism. The association between CKD stage and thyroid dysfunction was statistically significant ($\chi^2 = 13.8$, $p = 0.031$).

Table 4: Correlation of Renal Parameters with Thyroid Hormone Levels (N = 50)

Parameter	FT3 (r)	FT4 (r)	TSH (r)	p-value
Serum Creatinine	-0.52	-0.41	+0.38	0.002
Blood Urea	-0.48	-0.36	+0.34	0.004
eGFR	+0.55	+0.42	-0.40	0.001

Correlation analysis demonstrated that serum creatinine had a moderate negative correlation with FT3 ($r = -0.52$) and FT4 ($r = -0.41$), and a positive correlation with TSH ($r = +0.38$). Similarly, blood urea showed a negative correlation with FT3 ($r = -0.48$) and FT4 ($r = -0.36$), and a positive correlation with TSH ($r = +0.34$). In contrast, eGFR showed a positive correlation with FT3 ($r = +0.55$) and FT4 ($r = +0.42$), and a negative correlation with TSH ($r = -0.40$). All observed correlations were statistically significant ($p < 0.05$).

DISCUSSION

1. Demographic and Clinical Profile

In the present study, the majority of patients were in the 51–60 years age group (30.0%), with a male predominance (62.0%). This demographic pattern is consistent with the known epidemiology of chronic kidney disease, where advancing age and male gender are associated with higher disease burden and progression [1,2]. Similar findings were reported by Kashif et al. [5], who observed a higher prevalence of CKD among middle-aged males, and Ansari et al. [6], who also documented male predominance in their cohort.

A higher proportion of patients in the present study were in advanced CKD stages (stage 4 and 5: 56.0%), reflecting late presentation to tertiary care centers. Comparable observations were made by Shakya et al. [7], where most patients belonged to advanced stages, and Raj et al. [10], who reported a predominance of stage 4 and 5 CKD cases in hospital-based studies.

2. Prevalence of Thyroid Dysfunction

The present study demonstrated a high prevalence of thyroid dysfunction (76.0%) among CKD patients, with only 24.0% being euthyroid. This is comparable to the findings of Ansari et al. [6], who reported a high prevalence of thyroid abnormalities in CKD patients across various stages. Similarly, Obasuyi et al. [8] documented a broad spectrum of thyroid dysfunction in CKD, highlighting its frequent occurrence in this population.

The increased prevalence observed in CKD patients compared to the general population can be explained by impaired renal clearance of iodine, altered hormone metabolism, and the effects of uremia on the hypothalamic–pituitary–thyroid axis [3,4]. These mechanisms collectively contribute to significant endocrine alterations in CKD patients.

3. Pattern of Thyroid Dysfunction

In the present study, low T3 syndrome was the most common thyroid abnormality (36.0%), followed by subclinical hypothyroidism (26.0%) and overt hypothyroidism (14.0%). A similar pattern was reported by Ansari et al. [6], who observed low T3 syndrome as the predominant abnormality in CKD patients. Kashif et al. [5] also demonstrated a higher prevalence of reduced T3 levels, particularly in patients with advanced CKD.

The predominance of low T3 syndrome can be attributed to reduced peripheral conversion of T4 to T3 due to decreased activity of deiodinase enzymes, which is influenced by chronic inflammation, metabolic acidosis, and cytokine-mediated inhibition [3]. Additionally, Kim et al. [9] highlighted the increased prevalence of subclinical hypothyroidism in CKD, suggesting its role as both a consequence and a potential contributor to renal dysfunction.

4. Association Between CKD Severity and Thyroid Dysfunction

A statistically significant association was observed between CKD stage and thyroid dysfunction in the present study ($p = 0.031$), with increasing prevalence of thyroid abnormalities in advanced stages. This trend is consistent with the findings of Shakya et al. [7], who demonstrated a higher frequency of thyroid dysfunction in end-stage

renal disease patients. Similarly, Ansari et al. [6] reported a progressive increase in thyroid abnormalities with declining renal function.

The observed association supports the concept of a bidirectional relationship between thyroid and kidney function, as described by Narasaki et al. [3], where worsening renal function leads to altered thyroid hormone metabolism, and thyroid dysfunction may further contribute to renal impairment.

5. Correlation Between Renal Parameters and Thyroid Hormones

The present study demonstrated a significant negative correlation between serum creatinine and FT3 ($r = -0.52$) and FT4 ($r = -0.41$), along with a positive correlation with TSH ($r = +0.38$). Blood urea showed a similar pattern, while eGFR demonstrated a positive correlation with FT3 ($r = +0.55$) and FT4 ($r = +0.42$), and a negative correlation with TSH ($r = -0.40$).

These findings are in agreement with Ansari et al. [6], who reported declining T3 and T4 levels with increasing serum creatinine, and Kashif et al. [5], who observed similar correlations between renal parameters and thyroid hormones. Narasaki et al. [3] further explained that reduced T3 levels in CKD are primarily due to impaired peripheral deiodination and inflammatory cytokine activity.

The positive correlation between TSH and worsening renal function observed in this study may be attributed to altered hormone clearance and dysregulation of the hypothalamic–pituitary axis in CKD patients [4].

6. Clinical Implications

The high prevalence of thyroid dysfunction and its significant association with CKD severity observed in the present study emphasize the importance of routine thyroid function screening in CKD patients. Similar recommendations have been proposed by Kim et al. [9], who highlighted the clinical significance of early detection of subclinical hypothyroidism in CKD.

Given the potential impact of thyroid dysfunction on cardiovascular risk, metabolic status, and overall clinical outcomes, incorporation of thyroid function testing into routine CKD evaluation may facilitate early diagnosis and appropriate management, thereby improving patient outcomes [3,9].

Strengths and Limitations

The present study has several strengths, including inclusion of patients across all CKD stages (1–5), enabling stage-wise analysis, and assessment of a complete thyroid profile (T3, T4, FT3, FT4, TSH). It also evaluated both association and correlation with renal parameters using standardized KDIGO-based staging.

However, the study has certain limitations. The sample size was small ($n = 50$) and it was conducted at a single center, limiting generalizability. The cross-sectional design precludes causal inference, and thyroid autoantibodies and long-term follow-up were not assessed.

CONCLUSION

The present study demonstrates a high prevalence of thyroid dysfunction in patients with chronic kidney disease, with low T3 syndrome emerging as the predominant abnormality, followed by subclinical and overt hypothyroidism. A statistically significant association between thyroid dysfunction and CKD stage was observed, with a progressive increase in abnormalities in advanced stages of renal impairment. Furthermore, thyroid hormone parameters showed significant correlations with renal function indices, indicating a close and clinically relevant interplay between declining kidney function and altered thyroid status.

These findings underscore the importance of routine evaluation of thyroid function in CKD patients, particularly in advanced stages, to facilitate early detection and appropriate clinical management. Incorporation of thyroid assessment into standard CKD care protocols may aid in optimizing patient outcomes and addressing potentially reversible endocrine abnormalities.

Author's Contributions

All authors contributed to data interpretation, manuscript revision, and approved the final version.

Financial Support and Sponsorship

Nil.

Conflict of Interest

The authors declare no conflict of interest.

REFERENCES

1. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease. *Kidney Int Suppl.* 2013;3(1):1–150.
2. Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J, editors. *Harrison's Principles of Internal Medicine*. 20th ed. New York: McGraw-Hill Education; 2018.
3. Narasaki Y, Sohn P, Rhee CM. The interplay between thyroid dysfunction and kidney disease. *Semin Nephrol.* 2021;41(2):133–143.
4. Iglesias P, Diez JJ. Thyroid dysfunction and kidney disease. *Clin J Am Soc Nephrol.* 2009;4(11):1849–1860.
5. Kashif M, Hussain MS, Anis M, Shah PK. Thyroid dysfunction and chronic kidney disease: a study among the northeastern population of India. *Cureus.* 2023;15(5):e38700.
6. Ansari I, Kumar S, Acharya S, Agrawal S, Saboo K. Thyroid dysfunction at different stages of chronic kidney disease: a cross-sectional study at a rural teaching college in central India. *Cureus.* 2023;15(7):e42130.
7. Shakyia S, Kumar S, Verma V, Gupta H, Sonkar SK, Atam V. Evaluation of interactions between thyroid dysfunction in end-stage renal disease patients: a cross-sectional study. *Cureus.* 2023;15(2):e35088.
8. Obasuyi JO, Emokpae MA. Spectrum of thyroid dysfunction in patients with chronic kidney disease in Benin City, Nigeria. *Medicines (Basel).* 2023;10(8):47.
9. Kim HJ, Park SJ, Park HK, Byun DW, Suh K, Yoo MH. Subclinical thyroid dysfunction and chronic kidney disease: a nationwide population-based study. *BMC Nephrol.* 2023;24:64.
10. Raj R, Kumar V, Bhushan D, Biswas R, Ojha VS. The prevalence of thyroid abnormalities in patients with chronic kidney disease: a cross-sectional study at a tertiary care hospital. *Cureus.* 2023;15(8):e43065.