International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Prevalence of Thyroid Dysfunction in Patients with Chronic Kidney Disease – A Cross-Sectional Study

Nishant Deb[1], Alokananda Purakaystha[2], Biswadeep Choudhury[3]

[1]Post Graduate Trainee, Department of Biochemistry, Silchar Medical College & Hospital, Silchar- 788014
[2]Demonstrator, Department of Biochemistry, Silchar Medical College & Hospital, Silchar- 788014
[3]Professor & Head, Department of Biochemistry, Silchar Medical & Hospital, Silchar- 788014

Abstract

Background: Chronic Kidney Disease (CKD) affects multiple organ systems including the endocrine axis. Thyroid dysfunction, particularly hypothyroidism, is common among CKD patients due to alterations in thyroid hormone metabolism and excretion. Chronic kidney disease (CKD) is characterized by a low T3 syndrome which is now considered a part of an atypical nonthyroidal illness.

Objective: To assess the prevalence of thyroid dysfunction in adult patients with chronic kidney disease and explore associations between thyroid hormone levels and renal function parameters.

Methods: A hospital-based cross-sectional observational study was conducted on 50 adult CKD patients. Thyroid function tests (TSH, FT3, FT4) and serum creatinine were measured. Statistical analysis included descriptive statistics, correlation analysis, and chi-square tests.

Results: The mean age was 58.20 ± 14.73 years with 54% males. Overall thyroid dysfunction prevalence was 56%, with subclinical hypothyroidism being most common (40%), followed by overt hypothyroidism (8%), low T3 syndrome (4%), and subclinical hyperthyroidism (4%). Mean TSH was 7.47 ± 20.93 mIU/L, FT4 was 1.36 ± 0.60 ng/dL, and FT3 was 2.87 ± 0.72 pg/mL. A statistically significant association was found between CKD stage and thyroid dysfunction ($\chi^2 = 6.30$, $p = 0.043$). However, no significant correlation was observed between individual thyroid parameters and serum creatinine levels.

Conclusion: Thyroid dysfunction, particularly subclinical hypothyroidism, is highly prevalent in CKD patients. Regular thyroid screening should be considered in CKD management protocols.

Keywords: Chronic kidney disease, thyroid dysfunction, subclinical hypothyroidism, TSH, CKD staging

Introduction

Chronic kidney disease (CKD) represents a significant global health burden, with prevalence ranging from 5.8% to 13.1% across different populations, particularly affecting the elderly [1][2]. The bidirectional relationship between thyroid function and kidney disease has gained increasing attention in recent years, as both organs influence each other's function through complex physiological mechanisms.

Thyroid hormones play crucial roles in maintaining normal renal function by regulating glomerular filtration rate (GFR), tubular secretion and reabsorption, and electrolyte homeostasis [3]. Conversely, CKD affects thyroid hormone metabolism through reduced peripheral conversion of T4 to T3, altered protein

binding, and accumulation of uremic toxins that interfere with thyroid hormone synthesis and action. The prevalence of thyroid dysfunction in CKD patients varies widely across studies, with hypothyroidism being the most commonly reported abnormality.

Despite the recognized association, the exact prevalence and patterns of thyroid dysfunction in CKD patients remain incompletely characterized, particularly in Indian populations. Understanding this relationship is clinically important as thyroid dysfunction can complicate CKD progression, impact mortality rates, and affect overall quality of life. Moreover, the physiological benefits of a hypothyroid state in CKD and the potential risks of hyperthyroidism emphasize the need for careful evaluation before therapeutic intervention [3].

This study aimed to assess the prevalence of thyroid dysfunction in adult patients with chronic kidney disease and explore associations between thyroid hormone levels and renal function parameters in a hospital-based setting.

Materials and Methods

Study Design and Setting

This was a hospital-based, cross-sectional, observational study conducted in the Biochemistry section of Composite Central Laboratory and Department of General Medicine over a period of six months. The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants.

Study Population

A total of 50 adult patients diagnosed with CKD were enrolled in the study.

Inclusion Criteria:

- Adults aged 18 years or above
- Willing to participate and provide informed consent

Exclusion Criteria:

- Pregnant or lactating women
- Known thyroid disease or already on thyroid medications
- Acute kidney injury
- Patients on medications affecting thyroid function (corticosteroids, amiodarone, lithium)

Data Collection and Laboratory Methods

Detailed clinical history including age, gender, comorbidities, and medication history was recorded for all participants. Venous blood samples were collected after overnight fasting for biochemical analysis.

Laboratory Parameters:

- Serum creatinine measured by enzymatic method
- Thyroid Stimulating Hormone (TSH) by chemiluminescent immunoassay
- Free T4 (FT4) by chemiluminescent immunoassay
- Free T3 (FT3) by chemiluminescent immunoassay

Reference Ranges:

- TSH: 0.4-4.5 mIU/L
- FT4: 0.8-1.8 ng/dL
- FT3: 2.3-4.2 pg/mL

Classification Criteria

CKD Staging: Based on serum creatinine levels as a marker, patients were categorized into:

- Mild: Creatinine 1.5-3.0 mg/dL
- Moderate: Creatinine 3.0-6.0 mg/dL
- Severe: Creatinine > 6.0 mg/dL

Thyroid Status Classification:

- Euthyroid: TSH 0.4-4.5 mIU/L with normal FT4 and FT3
- Subclinical Hypothyroidism: TSH > 4.5 mIU/L with normal FT4
- Overt Hypothyroidism: TSH > 4.5 mIU/L with FT4 < 0.8 ng/dL
- Subclinical Hyperthyroidism: TSH < 0.4 mIU/L with normal FT4
- Overt Hyperthyroidism: TSH < 0.4 mIU/L with FT4 > 1.8 ng/dL
- Low T3 Syndrome: FT3 < 2.3 pg/mL with normal TSH

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Python statistical libraries. Descriptive statistics were presented as mean ± standard deviation for continuous variables and frequency with percentages for categorical variables. Pearson correlation coefficient was used to assess linear relationships between continuous variables. Chi-square test was used for categorical associations. One-way ANOVA was performed to compare means across multiple groups. Linear regression analysis was conducted to evaluate predictive relationships. A p-value < 0.05 was considered statistically significant.

Results

Demographic and Clinical Characteristics

A total of 50 patients with CKD were enrolled in the study. The mean age of participants was 58.20 ± 14.73 years (range: 27-86 years). The study population comprised 27 males (54.0%) and 23 females (46.0%), showing a nearly equal gender distribution. The baseline characteristics are summarized in Table 1.

Parameter	Value
Age (years), mean ± SD	58.20 ± 14.73
Age range (years)	27-86
Gender, n (%)	
Male	27 (54.0%)
Female	23 (46.0%)
Serum Creatinine (mg/dL), mean ± SD	4.38 ± 2.26
Creatinine range (mg/dL)	1.93-10.76
CKD Stage, n (%)	
Mild	15 (30.0%)
Moderate	23 (46.0%)
Severe	12 (24.0%)

Table 1: Baseline characteristics of study participants (N=50)

The majority of patients (46.0%) were in moderate CKD stage, followed by mild (30.0%) and severe (24.0%). The mean serum creatinine level was 4.38 ± 2.26 mg/dL, reflecting moderate to severe renal impairment in the study cohort.

Thyroid Function Parameters

The thyroid function parameters of the study population are presented in Table 2. The mean TSH level was 7.47 ± 20.93 mIU/L with a median of 3.81 mIU/L, showing considerable variability and a right-skewed distribution. One patient showed markedly elevated TSH (150.00 mIU/L), indicating severe overt hypothyroidism.

Parameter	Mean ± SD	Median	Range
TSH (mIU/L)	7.47 ± 20.93	3.81	0.30-150.00
FT4 (ng/dL)	1.36 ± 0.60	1.27	0.20-4.26
FT3 (pg/mL)	2.87 ± 0.72	2.70	1.30-5.40

Table 2: Thyroid function parameters in CKD patients (N=50)

The mean FT4 level was 1.36 ± 0.60 ng/dL (median: 1.27 ng/dL), and the mean FT3 level was 2.87 ± 0.72 pg/mL (median: 2.70 pg/mL). The relatively wide range of values reflects the heterogeneity of thyroid dysfunction in the CKD population.

Prevalence of Thyroid Dysfunction

Table 3 presents the distribution of thyroid status among the study participants. Out of 50 patients, 28 (56.0%) had some form of thyroid dysfunction, while 22 (44.0%) were euthyroid.

Thyroid Status	Number	Percentage (%)
Euthyroid	22	44.0
Subclinical Hypothyroidism	20	40.0
Overt Hypothyroidism	4	8.0
Low T3 Syndrome	2	4.0
Subclinical Hyperthyroidism	2	4.0
Total Dysfunction	**28**	**56.0**

Table 3: Prevalence and types of thyroid dysfunction in CKD patients (N=50)

Subclinical hypothyroidism was the most common thyroid abnormality, affecting 20 patients (40.0%), followed by overt hypothyroidism in 4 patients (8.0%). Combined, hypothyroidism (subclinical and overt) accounted for 48.0% of the study population. Low T3 syndrome was observed in 2 patients (4.0%), and subclinical hyperthyroidism was found in 2 patients (4.0%). No cases of overt hyperthyroidism were identified.

Correlation Between Thyroid Parameters and Renal Function

Table 4 summarizes the correlation analysis between thyroid hormone levels and serum creatinine.

Variables	r-value	p-value	Significance
TSH vs Creatinine	0.132	0.361	NS
FT4 vs Creatinine	0.096	0.506	NS
FT3 vs Creatinine	-0.174	0.228	NS
FT3 vs FT4	0.394	0.005	S

Table 4: Correlation between thyroid parameters and renal function (N=50)

Note: S = Significant ($p < 0.05$), NS = Not Significant ($p \geq 0.05$)

No statistically significant correlations were found between TSH, FT4, or FT3 levels and serum creatinine. However, a significant positive correlation was observed between FT3 and FT4 ($r = 0.394$, $p = 0.005$), suggesting preserved peripheral thyroid hormone relationships despite renal impairment. The weak

negative correlation between FT3 and creatinine (r = -0.174, p = 0.228) suggests a trend toward lower T3 levels with worsening renal function, though this did not reach statistical significance in our cohort.

Association Between CKD Stage and Thyroid Dysfunction

A statistically significant association was found between CKD stage and thyroid dysfunction ($\chi^2 = 6.30$, p = 0.043). The prevalence of thyroid dysfunction was notably higher in moderate CKD (73.9%) compared to mild (33.3%) and severe (50.0%). Subclinical hypothyroidism showed a marked increase from mild (13.3%) to moderate (56.5%), before declining slightly in Severe (41.7%).

CKD Stage	Euthyroid	SCH	Overt Hypo	Low T3	SC Hyper	Total
Mild	10 (66.7%)	2 (13.3%)	1 (6.7%)	1 (6.7%)	1 (6.7%)	15
Moderate	6 (26.1%)	13 (56.5%)	2 (8.7%)	1 (4.3%)	1 (4.3%)	23
Severe	6 (50.0%)	5 (41.7%)	1 (8.3%)	0 (0.0%)	0 (0.0%)	12
Total	22	20	4	2	2	50

Table 5: Distribution of thyroid dysfunction across CKD stages (N=50)

SCH = Subclinical Hypothyroidism; Overt Hypo = Overt Hypothyroidism; SC Hyper = Subclinical Hyperthyroidism

When comparing mean creatinine levels across thyroid status groups, no significant difference was found (ANOVA: F = 0.329, p = 0.857). The mean ages were higher in patients with overt hypothyroidism (66.00 ± 8.98 years) and subclinical hypothyroidism (63.00 ± 13.30 years) compared to euthyroid patients (53.14 ± 16.45 years), though this difference was not statistically significant.

No significant association was observed between gender and thyroid dysfunction ($\chi^2 = 0.622$, p = 0.430), with dysfunction rates being similar in males (63.0%) and females (47.8%).

Discussion

This cross-sectional study demonstrates a high prevalence of thyroid dysfunction in patients with chronic kidney disease, with 56% of patients showing some form of abnormality. Subclinical hypothyroidism was the predominant finding, affecting 40% of the cohort, followed by overt hypothyroidism (8%), low T3 syndrome (4%), and subclinical hyperthyroidism (4%). These findings underscore the complex interplay between thyroid and renal function and have important implications for the clinical management of CKD patients.

The prevalence of thyroid dysfunction in our study (56%) is notably higher than several previously reported studies. Managooli *et al* [4], in their study at Goa Medical College, found a lower prevalence with only 7% hypothyroidism and 2% hyperthyroidism, with most participants being euthyroid. The most common abnormality in their study was low T3 values (non-thyroidal illness), whereas our study found subclinical hypothyroidism to be most prevalent.

The discrepancy may be attributed to several factors. First, our study population had more advanced CKD, with 46% in moderate and 24% in severe, compared to potentially earlier stages in the Goa study. Second, differences in population characteristics, including age distribution and comorbidities, may contribute to

varying prevalence rates. Our mean age of 58.20 years represents a population at higher risk for both thyroid and kidney dysfunction.

Raj et al. [5], in their tertiary care hospital study, also emphasized the significant burden of hypothyroidism in CKD patients and its impact on disease progression and quality of life. Our findings align with their observations regarding the clinical importance of thyroid screening in CKD populations.

The study by Gao and Liu [6] on diabetic kidney disease reported significant hypothyroidism prevalence, especially in advanced CKD stages. Our results support this finding, as we observed a statistically significant association between CKD stage and thyroid dysfunction ($p = 0.043$), with moderate CKD showing the highest prevalence of subclinical hypothyroidism (56.5%).

Interestingly, the Tehran Thyroid Study by Kazempour-Ardebili et al. [7] found that the prevalence of subclinical hypothyroidism was not significantly higher in CKD patients (7.3%) compared to non-CKD individuals (5.2%) after controlling for confounding factors. This population-based study suggests that apparent associations may sometimes be influenced by demographic and metabolic factors rather than CKD per se. However, our hospital-based study with more advanced CKD stages shows a substantially higher prevalence (40% subclinical hypothyroidism), suggesting that severity of renal impairment may be a critical factor.

The high prevalence of hypothyroidism in our CKD cohort can be explained through multiple mechanisms described by Basu and Mohapatra [3]. CKD affects thyroid function through decreased peripheral conversion of T4 to T3 by type I deiodinase, altered protein binding due to uremia, decreased renal clearance of iodine leading to intrathyroidal iodine overload, and accumulation of uremic toxins that interfere with thyroid hormone synthesis and receptor binding.

Conversely, hypothyroidism affects renal function by reducing cardiac output and renal blood flow, thereby decreasing GFR. This bidirectional relationship creates a potential vicious cycle where worsening renal function exacerbates thyroid dysfunction, which in turn may contribute to further renal deterioration.

The lack of significant correlation between TSH and creatinine ($r = 0.132$, $p = 0.361$) indicates that thyroid dysfunction in CKD may not be simply proportional to the degree of renal impairment but rather influenced by multiple factors including age, comorbidities, medications, and individual variation in thyroid-kidney axis regulation.

The high prevalence of subclinical hypothyroidism (40%) in our study raises important questions about screening and treatment strategies. Liao et al [1][2] have shown conflicting evidence regarding the association between elevated TSH and mortality in elderly CKD patients, emphasizing the need for individualized approaches rather than universal treatment protocols.

The physiological benefits of a relatively hypothyroid state in CKD, including reduced metabolic demands and potential nephroprotective effects, must be weighed against risks such as dyslipidemia, cardiovascular complications, and impaired quality of life [3]. The conservative approach suggested in the literature appears prudent, recommending treatment primarily for symptomatic patients or those with markedly elevated TSH levels.

Our finding of a significant association between CKD stage and thyroid dysfunction suggests that thyroid screening should be intensified in patients with advancing CKD, particularly moderate. Regular monitoring may allow early detection and appropriate management of thyroid abnormalities before they contribute to clinical deterioration.

Strengths and Limitations

The strengths of this study include comprehensive thyroid function assessment with measurement of TSH, FT3, and FT4, standardized classification of both CKD stages and thyroid status, and rigorous statistical analysis including correlation, and categorical associations.

However, several limitations should be acknowledged. The sample size of 50 patients, while adequate for preliminary assessment, limits statistical power for subgroup analyses and detection of modest associations. The cross-sectional design prevents assessment of temporal relationships and causality. We did not measure anti-thyroid antibodies to distinguish primary autoimmune thyroid disease from CKD-related thyroid dysfunction. The use of creatinine-based CKD staging, rather than measured or estimated GFR, is less precise, particularly in elderly patients or those with altered muscle mass. Finally, we did not collect data on thyroid-related symptoms, medications that might affect thyroid function beyond our exclusion criteria, or longitudinal outcomes.

Future Directions

Longitudinal studies are needed to determine whether thyroid dysfunction in CKD is a cause or consequence of renal deterioration, and whether treatment of thyroid abnormalities can slow CKD progression or improve clinical outcomes. Prospective randomized trials could evaluate the benefits and risks of thyroid hormone replacement in CKD patients with subclinical hypothyroidism. Studies measuring anti-thyroid antibodies would help distinguish primary thyroid disease from CKD-induced dysfunction. Investigation of the role of uremic toxins in thyroid dysfunction could identify novel therapeutic targets. Finally, larger multicenter studies with diverse populations would provide more generalizable estimates of thyroid dysfunction prevalence in various CKD stages and etiologies.

Conclusion

This study demonstrates a high prevalence (56%) of thyroid dysfunction in patients with chronic kidney disease, with subclinical hypothyroidism being the most common abnormality (40%). A statistically significant association exists between CKD stage and thyroid dysfunction, with moderate patients showing the highest prevalence. While individual thyroid parameters showed no significant correlation with serum creatinine levels, the overall burden of thyroid abnormalities warrants routine thyroid function screening in CKD patients, particularly those with advanced disease.

The complex interplay between thyroid and kidney function necessitates an individualized approach to diagnosis and management. Given the high prevalence of subclinical hypothyroidism and its potential impact on CKD progression and quality of life, regular thyroid screening should be incorporated into standard CKD management protocols. However, treatment decisions should consider the physiological adaptations in CKD and focus on symptomatic patients or those with marked abnormalities.

Further longitudinal studies are needed to establish causal relationships and determine optimal management strategies for thyroid dysfunction in the CKD population.

References

1. Liao, M., Hung, M., Chou, C., & Chou, P. (2017). Association of TSH Elevation with All-Cause Mortality in Elderly Patients with Chronic Kidney Disease. *PLOS ONE*, 12(1), e0168611. https://doi.org/10.1371/journal.pone.0168611
2. Liao, M., Hung, M., Yung-Pou Wang, P., Chou, C., & Chou, P. (2016). Abnormal Thyroid-Stimulating

Hormone and Chronic Kidney Disease in Elderly Adults in Taipei City. *Journal of the American Geriatrics Society*, 64(6), 1267-1273. https://doi.org/10.1111/jgs.14102

3. Basu, G., & Mohapatra, A. (2012). Interactions between thyroid disorders and kidney disease. *Indian Journal of Endocrinology and Metabolism*, 16(2), 204-213. https://doi.org/10.4103/2230-8210.93737
4. Managooli, M., Nadekar, P.B., & Pauskar, M.M. (2024). A cross-sectional study of thyroid dysfunction in patients of chronic kidney disease in Goa medical college. *International Journal of Research in Medical Sciences*, 12(9), 3344-3350. https://www.msjonline.org/index.php/ijrms/article/view/13932
5. Raj, R., Kumar, V., Bhushan, D., Biswas, R., & Ojha, V.S. (2023). The Prevalence of Thyroid Abnormalities in Patients With Chronic Kidney Disease: A Cross-Sectional Study at a Tertiary Care Hospital. *Cureus*, 15(8), e43065. https://doi.org/10.7759/cureus.43065
6. Gao, J., & Liu, J. (2024). Correlation of serum thyrotropin and thyroid hormone levels with diabetic kidney disease: a cross-sectional study. *BMC Endocrine Disorders*, 24, 170. https://doi.org/10.1186/s12902-024-01699-x
7. Kazempour-Ardebili, S., Amouzegar, A., Tohidi, M., Amouzegar, A., & Azizi, F. (2021). Prevalence of Subclinical Hypothyroidism in Chronic Kidney Disease in a Population-based Study: Tehran Thyroid Study. *International Journal of Endocrinology and Metabolism*, 19(2), e103750. https://doi.org/10.5812/ijem.103750