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Research Article

Study On Renal Function Status in Patients with Hypothyroidism Attending a Tertiary Care Hospital at Kishanganj, Bihar

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ABSTRACT

Background: Thyroid hormones profoundly influence renal hemodynamics, glomerular filtration, tubular function, and electrolyte homeostasis. Hypothyroidism is associated with reduced renal blood flow and glomerular filtration rate (GFR), leading to mild renal dysfunction that may reverse after hormone replacement.
Objectives: To assess renal function status in hypothyroid patients and evaluate the relationship between thyroid hormone levels and renal function impairment.
Materials & Methods: This hospital-based cross-sectional study was conducted in the Department of Biochemistry, MGM Medical College & LSK Hospital, Kishanganj, Bihar, over 18 months. One hundred hypothyroid patients aged 18–70 years were enrolled after applying inclusion and exclusion criteria. Serum free triiodothyronine (fT3), free thyroxine (fT4), thyroid-stimulating hormone (TSH), urea, and creatinine were analyzed using chemiluminescent immunoassay and standard biochemical methods. Estimated GFR was calculated using the CKD-EPI (2021) equation. Statistical analysis was performed using SPSS v26; $p<0.05$ was considered significant.
Results: Among 100 subjects, the mean age was 57.3 ± 11.9 years with a male-to-female ratio of 1.63:1. Thyroid dysfunction was observed in 38% of CKD patients, predominantly subclinical hypothyroidism (27%), followed by overt hypothyroidism (8%) and subclinical hyperthyroidism (3%). Mean serum TSH levels increased significantly with CKD progression (Stage 3: 3.67 ± 3.6; Stage 4: 4.73 ± 3.7; Stage 5: 7.40 ± 3.8; $p = 0.003$). Serum urea and creatinine rose significantly with declining eGFR ($p< 0.0001$).
Conclusion: Renal dysfunction is common among hypothyroid patients, and the severity of hypothyroidism correlates with worsening renal function. Routine monitoring of thyroid function in CKD and renal profile in hypothyroid individuals is recommended for early intervention.

Keywords*:Hypothyroidism, Chronic Kidney Disease, eGFR, Thyroid Dysfunction, Biochemistry*

INTRODUCTION:

CKD is a long-term form of kidney disease; thus, it is differentiated from acute kidney disease (acute kidney injury) in that the reduction in kidney function must be present for over 3 months. CKD is an internationally recognized public health problem affecting 5-10% of the world population.[1]

According to the 2010 Global Burden of Disease study, chronic kidney disease was ranked 27th in the list of causes of total number of deaths worldwide in 1990, but rose to 18th in 2010. This degree of movement up the list was second only to that for HIV and AIDs.[2]

Over 2 million people worldwide currently receive treatment with dialysis or a kidney transplant to stay alive, yet this number may only represent 10% of people who actually need treatment to live.[3]

The reported prevalence of CKD in different regions ranges in India from <1% to 13%, and recently, data from the International Society of Nephrology's Kidney Disease Data Center Study reported a prevalence of 17%.[4]

The etiology of CKD varies considerably throughout India. Parts of the states of Andhra Pradesh, Odisha, and Goa have high levels of CKD of unknown etiology (CKDu), which is a chronic interstitial nephropathy with insidious onset and slow progression.[5]

Two studies reported the prevalence of CKD in India. It was 0.79% in a study from Delhi which screened 4972 adults. This study used a serum creatinine cut-off >1.8 mg/dl to define CKD and hence underestimating the prevalence.[6] . Another study by **Mani et al**. in a south Indian village reported the prevalence of GFR<15 ml/min (CKD stage 5) to be 0.09%5 .Based on the current Indian population of 1.2 billion, even a conservative estimate of end stage kidney disease(ESRD) burden in India would suggest that about 1,650,000 to 2,200,000 people develop ESRD every year.[7]

Thyroid hormones play a very important role regulating metabolism, development, protein synthesis, and influencing other hormone functions. The two main hormones produced by the thyroid are triiodothyronine (T3) and thyroxine (T4). These hormones can also have significant impact on kidney disease so it is important to consider the physiological association of thyroid dysfunction in relation to chronic kidney disease (CKD). CKD has been known to affect the pituitary-thyroid axis and the peripheral metabolism of thyroid hormones. Low T3 levels are the most common laboratory finding followed by subclinical hypothyroidism in CKD patients. Hyperthyroidism is usually not associated with CKD but has been known to accelerate it. One of the most important links between thyroid disorders and CKD is uremia. Patients who are appropriately treated for thyroid disease have a less chance of developing renal dysfunction.[8]
On the other hand, CKD and progression toward ESRD expose patients to premature vascular disease and excess cardiovascular morbidity and mortality.[9] The reasons for the elevated risk of cardiovascular disease (CVD) in patients with CKD are not fully elucidated.[10]

This study is done to simplify the importance of interactions between thyroid function, and kidney disease. This information is essential as it shows a link three separate conditions. Information obtained from this study will help to increase clinical knowledge and we will be providing better management for those patients who have thyroid disorder in chronic kidney disease.

Objectives:
To assess renal function status in hypothyroid patients and evaluate the relationship between thyroid hormone levels and renal function impairment.

Materials & methods:
Study Area: The study conducted in the department of Biochemistry at tertiary care Hospital Kishanganj, Bihar.
Study Population: The patients attending General Medicine Outpatient and Inpatient Departments.
Study Period: 18 Months
Sample Size: Estimated sample size is 100.
Sample Size Calculation: Sample size calculation of any cross-sectional study based on the following formula: $n= z\alpha^2 * P * (1-P) / d^2$
[where n: required sample size;
z: standard normal variate,
α: alpha error,
value of zα =1.96 at 95% confidence interval (CI);
P: prevalence, and
d : allowable error]
Considering the reported prevalence of Thyroid Hormone Dysfunction among chronic kidney disease patients was 53%.[64]
5% alpha error and
10% absolute allowable error and
10% non-response rate.
The desired sample size was 96 by using the formula: (World Health Organization, Regional Office for the Western Pacific. Health Research Methodology: A Guide for Training in Research Methods, Second Edition. World Health Organization 2001)**.**[65]
Sample Design: Written and informed consent was taken from each of the study subject's kin and when possible directly from subjects.

Inclusion Criteria:

- Patients diagnosed with Chronic Kidney Disease according to eGFR calculated by the CKD EPI 2021 equation with Serum Creatinine as the biomarker.
- CKD patients with no previous history of thyroid hormone dysfunction.

Exclusion Criteria:

- Patients who are unwilling to participate in the study.
- Patient with active infection or Sepsis , Uremic Encephalopathy
- Other conditions like: Diabetic nephropathy, recent surgery, trauma or burns, liver disease etc.
- Patient already receiving drugs for thyroid hormone dysfunction.
- Patients on Dialysis
- Patients who received drugs altering thyroid profile like phenytoin, beta blocker, steroid, amiodarone etc.

Study Design: Cross sectional, hospital based single centre study.

Operational Definition:

Chronic Kidney Disease: At first Serum Creatinine Level of patients symptomatic of Chronic Kidney Diseasewas measured. The eGFR of the patients was calculated using 2021 CKD EPI EQUATIONS FOR GFR (with Serum Creatinine as the biomarker).[66]

Ultrasonography of the kidney was performed. Shrunken Kidney, raised cortical echogenicity and loss of Corticomedullary Differentiation are signs of permanent damage to the Kidneys. Only patients with eGFR </= 60 mL/min/1.73 sq.m (i.e. Stage 3A, 3B, 4, 5 of Chronic Kidney Disease according to KDIGO CLASSIFICATION OF CHRONIC KIDNEY DISEASE) and Ultrasonography showing permanent changes to the Kidney was taken into consideration for Study.

Thyroid dysfunction was considered if patient's thyroid hormones fall outside the reference range. The expected normal range of free T3(2.6-4.4 pg/ml), free T4(1.0-1.6 ng/dl), and TSH(0.27-4.2 uIU/ml) were considered.

Hypertension: Clinical criteria for defining hypertension generally have been based on the average of two or more seated blood pressure reading during each of two or more outpatient visits. One recent classification recommends hypertension to be defined as systolic blood pressure more or equal to 130mmHg or diastolic blood pressure more or equal to 80mmHg.[67]

BMI: According to the NHLBI, BMI is calculated as weight in kilograms divided by the square of the height in meters (kg/m2) and was categorized into four groups according to the Asian-Pacific cutoff points : underweight (<17.5 kg/m2), normal weight (17.5–22.9 kg/m2), overweight (23–27.4 kg/m2), and obese (≥27.5 kg/m2).

Parameters to be studied:

Sample Collection: After 12 h of fasting, an early morning blood sample was taken from each subject and kept standing to clot. Serum was separated and analyzed after centrifugation.

Measurement of thyroid hormone profile: Thyroid function test comprising of free T3(2.6-4.4 pg/ml), freeT4(1.0-1.6 ng/dl),andTSH(0.27-4.2 uIU/ml) levels measurement were done by ChemiluminiscentImmmunoassay[CLIA] method using immulite 1000[Siemens Inc, Germany] automated analyser.

Measurement of Urea and Creatinine: Serum urea(Normal value- 20-40mg/dl) level measurement done by using Berthelot method(Liquid stable), and serum creatinine(Male – 0.6-1.2mg/dl,Female- 0.5-1.0mg/dl) level measurement was done by Modified Jaffe's method(Fixed Time Kinetic).

Mode of Selection of Cases: Consecutive eligible willing persons till the sample size was fulfilled.

Plan for Data Analysis: Data collected during study was entered in Microsoft Excel spreadsheet, analysed statistically using appropriate software like SPSS, Chi square test, unpaired t test, ANOVA and student t test. A p value of <0.05 was considered statistically significant.

Results & Analysis:

Table 1: Age Distribution

Age Group	Frequency	Percentage
18-30 years	2	2.0
31-40 years	6	6.0
41-50 years	21	21.0
51-60 years	28	28.0
61-70 years	30	30.0
>70 years	13	13.0
Total	100	100.0
Mean Age	57.33 ±11.87	

Among total 100 patients in our study, majority were aged from 61-70years constituting 30% patients followed by 51-60 years (28%), 41-50 years (21%) and >70 years (13%) with a mean age of 57.33 ±11.87 years. Data is shown in Table 1.

Table 2: Sex Distribution

Sex	Frequency	Percentage
Male	62	62.0
Female	38	38.0
Total	100	100.0
Male: Female Ratio	1.63:1	

Among 100 patients, 62weremales and 38 were females constituting 62 % and 32%respectively with a male to female ratio of 1.63:1. Data is shown in **Table 2**.

Table: 3. Area Distribution

Area	Frequency	Percentage
Rural	69	69.0
Urban	31	31.0
Total	100	100.0

Table 3 shows the distribution of participants based on area. A majority of the participants, 69% (69), were from rural areas, while 31% (31) were from urban areas.

Table: 4. Occupational status (Modified Kuppuswamy socioeconomic scale 2023)

Occupation	Frequency	Percentage
Legislators, senior officials, managers	0	0.0
Professional	1	1.0
Technicians/associate professionals	2	2.0
Clerk	4	4.0
Skilled worker, shop and market sales workers	15	15.0
Skilled agricultural and fishery workers	14	14.0
Craft and related trade workers	22	22.0
Plant and machine operators and assemblers	10	10.0
Elementary occupation	11	11.0
Unemployed	21	21.0
Total	100	100.0

Table 4 presents the occupational status of participants according to the Modified Kuppuswamy socioeconomic scale (2023). The distribution shows that there were no participants in the categories of legislators, senior officials, or managers. A small proportion of participants were professionals (1%) and technicians/associate professionals (2%). The largest groups were craft and related trade workers (22%), skilled workers, shop, and market sales workers (15%), and skilled agricultural and fishery workers (14%). Other notable categories include clerks (4%), plant and machine operators and assemblers (10%), and elementary occupation workers (11%). Additionally, 21% of participants were unemployed.

Table 5: Associated Diseases

Associated Diseases	Frequency	Percentage
Hypertension	70	70.0
Cardio Vascular Diseases	47	47.0
Diabetes Mellitus	45	45.0
Dyslipidemia	36	36.0
Total	100	100.0

Besides CKD regarding associated diseases we found 70% had hypertension, 47% had cardio vascular disease and 45% had diabetes mellitus while 36% had dyslipidemia. Data is illustrated in **Table 5**.

Table 6: BMI Distribution

BMI	Frequency	Percentage
Underweight (<17.5 kg/m^2)	3	3.0

Normal (17.5 -22.9 kg/m^2)	24	24.0
Overweight (23.0-27.4 kg/m^2)	35	35.0
Obesity (≥27.5 kg/m^2)	38	38.0
Total	100	100.0

According to BMI distribution 3% were underweight, 24% had normal BMI, 35% were overweight while 38% were obese. Data is shown in **Table 6**.

Table 7: Duration of Chronic Kidney Disease Symptoms

Duration	Frequency	Percentage
≤6 months	30	30.0
7-12 months	42	42.0
13-18 months	9	9.0
19-24 months	6	6.0
>24 months	13	13.0
Total	100	100.0

Table 7 presents the distribution of the study subjects according to duration of symptoms. Majority of the study subjects had symptom for ≤12 months (72%).

Table 8: CKD Staging

CKD Staging	Frequency	Percentage
CKD Stage 3	40	40.0
CKD Stage 4	43	43.0
CKD Stage 5	17	17.0
Total	100	100.0

Out of total 100 cases of CKD 40% had stage 3, 43% had stage 4 and 17% had stage 5 CKD. Data is illustrated in **Table8**.

Table 9: Incidence of Thyroid Dysfunction

Incidence of Thyroid Dysfunction	Frequency	Percentage
Present	38	38.0
Absent	62	62.0
Total	100	100.0

Prevalence of thyroid dysfunction was 38% in the present study. Data is shown in **Table 9**.

Table 10: Type of Thyroid Dysfunction

Type of Thyroid Dysfunction	Frequency	Percentage
Euthyroidism	62	62.0
Subclinical Hypothyroidism	27	27.0
Overt Hypothyroidism	8	8.0
Subclinical Hyperthyroidism	3	3.0
Total	100	100.0

Regarding the type of thyroid dysfunction we found that 27% had subclinical hypothyroidism, 8% had overt hypothyroidism and 3% had subclinical hyperthyroidism. And remaining 62% were euthyroid. Data is presented in **Table 10**.

Table 11: Incidence of Thyroid Dysfunction according to CKD Staging

Type of Thyroid Dysfunction	Stage3 (n=40)		Stage 4 (n=43)		Stage 5 (n=17)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Euthyroidism	29	72.5	25	58.1	8	47.1
Subclinical Hypothyroidism	6	15.0	14	32.6	7	41.2

Overt Hypothyroidism	3	7.5	3	7.0	2	11.8
Subclinical Hyperthyroidism	2	5.0	1	2.3	0	0.0
Total	40	100.0	43	100.0	17	100.0

Thyroid dysfunction was found in 38% CKD patients, the most common thyroid dysfunction being subclinical hypothyroidism (27%). Subclinical hypothyroidism got significantly common with CKD progression. Prevalence of subclinical hypothyroidism in stage 3, stage 4 and stage 5 was 15%, 32.6% and 41.2 % respectively. Data is shown in **Table 11**.

Table 12: Mean Levels of Renal Function Variables according to CKD Staging

Variables	Stage3 (n=40)		Stage 4 (n=43)		Stage 5 (n=17)		p value
	Mean	±SD	Mean	±SD	Mean	±SD	
Urea (pg/ml)	56.95	±2.72	91.44	±3.97	115.94	±15.54	<0.0001
Creatinine (ng/dl)	1.94	±0.13	3.66	±0.46	10.52	±1.73	<0.0001
eGFR (ml/min/1.73 m^2)	36.40	±4.09	17.67	±2.65	6.12	±2.52	<0.0001

Mean levels of blood urea and serum creatinine increases significantly with progressing stage of CKD while mean eGFR reduces significantly with progressing stage of CKD (p value = <0.0001). Data is shown in **Table 12**.

Table 13: Mean Levels of Thyroid Function Variables according to CKD Staging

Variables	Stage3 (n=40)		Stage 4 (n=43)		Stage 5 (n=17)		p value
	Mean	±SD	Mean	±SD	Mean	±SD	
FT3 (pg/ml)	2.67	±0.67	2.84	±0.71	2.79	±0.73	0.544
FT4 (ng/dl)	1.22	±0.35	1.23	±0.27	1.18	±0.26	0.803
TSH (mIU/L)	3.67	±3.60	4.73	±3.69	7.40	±3.77	0.003

Mean levels of serum FT3among patients with CKD Stage 3, 4 and 5 was 2.67 ±0.67pg/ml, 2.84 ±0.71 pg/ml and 2.79 ±0.73 pg/ml respectively. Mean levels of FT4 was 1.22 ±0.35 ng/dl, 1.23 ±0.27 ng/dl and 1.18 ±0.26 ng/dl respectively among patients with CKD stage 3,4 and 5 respectively. Mean levels of serum FT3 and FT4 were not significantly different among patients with CKD sage 3,4 and 5 (p value = 0.544 and 0.803 respectively). However mean levels of serum TSH elevates significantly with advance stage of CKD (p value = 0.003). Data is shown in Table 13.

Discussion:

Chronic kidney disease (CKD) is an increasingly serious global health concern, with a prevalence of 8–16% worldwide and ranking as the 12th leading cause of death. In India, its prevalence ranges from 0.78% to 17.4%, with rising mortality and earlier onset compared to Western countries due to genetic, nutritional, and environmental factors.[11]

Thyroid dysfunction is one of the most common endocrine abnormalities in CKD, largely due to impaired hypothalamic–pituitary–thyroid axis regulation, reduced peripheral conversion of T4 to T3, and decreased clearance of iodine and thyroid hormones.[12] The prevalence of subclinical hypothyroidism increases as GFR declines, whereas hyperthyroidism remains uncommon.[13]

In our study conducted at MGM Medical College & LSK Hospital, Kishanganj, 100 CKD patients were evaluated. The mean age was 57.3 ± 11.9 years, comparable to findings by **Ilandevan et al.** (56.2 years)[14] and **Bhatele et al.** (60.0 years).[15] Males predominated (62%), consistent with reports by **Mukherjee et al.**[16] and **Khatiwada et al.**[17] Hypertension was the most frequent comorbidity (70%), aligning with previous studies.

The stage-wise distribution of CKD (Stage 3: 40%, Stage 4: 43%, Stage 5: 17%) matched findings from **Khatiwada et al.**[17]Thyroid dysfunction was observed in 38% of patients—subclinical hypothyroidism (27%) being the most common—similar to **Khatiwada et al.** (38.6%) [17] and **Gupta et al.**[18]The prevalence increased with advancing CKD, reaffirming the inverse relationship between GFR and thyroid function seen in studies by **Lo et al**.[13] and **Bhatele et al.**[15]

In our cohort, mean fT3 and fT4 levels declined non-significantly across CKD stages, while TSH increased significantly ($p = 0.003$), indicating progressive hypothyroid trends. Similar biochemical patterns were reported by **Punekar et al.**[18] and **Kashif et al**.[19] who found reduced T3 and T4 and elevated TSH in CKD patients compared to controls.

Overall, this study supports existing evidence that thyroid dysfunction—especially subclinical hypothyroidism—is frequent in CKD and intensifies with renal impairment. Early thyroid screening in CKD may aid in timely detection, improve cardiovascular outcomes, and potentially slow disease progression.

CONCLUSION

Chronic kidney disease (CKD) is a common, multifactorial condition often accompanied by thyroid dysfunction due to altered hormone metabolism and regulatory mechanisms. In this study, thyroid dysfunction was observed in 38% of CKD patients, with **subclinical hypothyroidism** being the most prevalent form. The severity of thyroid dysfunction increased with the progression of renal disease.

Regular assessment of thyroid function in CKD patients is essential for early detection and management, as timely correction may help improve metabolic balance, slow renal deterioration, and enhance overall clinical outcomes.

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