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Original Research Article

Hospital-Based Longitudinal Study to Assess the Correlation between Serum Uric Acid and Thyroid Profile of Female Patients with Primary Hypothyroidism

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Abstract

Background: As an endocrine condition, hypothyroidism affects numerous individuals, particularly among women, and is associated with widespread metabolic alterations. One area of growing interest is the relationship between thyroid dysfunction and serum uric acid levels, given that hypothyroidism may impair renal clearance and alter purine metabolism, thereby predisposing patients to hyperuricemia. Identifying such correlations could provide additional insights into the metabolic complications of hypothyroidism and help establish uric acid as a potential biomarker for disease monitoring.

Methods: A hospital-based longitudinal study was conducted at ESIC Bihta, Bihar, from July 2023 to April 2025. A total of 300 female patients aged 18–60 years with primary hypothyroidism were enrolled. Serum uric acid and thyroid profile were measured using standardized enzymatic and chemiluminescence immunoassay methods. Statistical analysis was performed using SPSS, applying Pearson's and Spearman's correlation coefficients, with $p < 0.05$ considered significant.

Results: At 6.1 ± 1.4 mg/dL, the average serum uric acid level was measured. The results showed that uric acid showed a positive relationship with TSH ($r = +0.42$, $p < 0.001$) and a negative association with fT3 ($r = -0.31$, $p = 0.002$) and fT4 ($r = -0.28$, $p = 0.004$).Subgroup analysis revealed stronger associations in newly diagnosed patients compared to those already on levothyroxine therapy.

Conclusion: The study establishes a significant relationship between hypothyroidism and elevated serum uric acid levels. Routine assessment of uric acid may serve as a cost-effective adjunct in the management of female hypothyroid patients, though larger multicentric studies with longer follow-up are necessary to confirm these findings.

Keywords: Hypothyroidism, Serum Uric Acid, Thyroid Profile, Correlation, ESIC Bihta.

Introduction

Women are over-represented in hypothyroidism, a common endocrine disease. Worldwide, 5–15% of women have hypothyroidism, a major public health issue [1]. Population studies show that one in ten Indians have thyroid dysfunction, most often hypothyroidism. When compared to men, women have a higher risk of problems with their thyroids due to hormonal, immunological, and genetic factors [2].

Untreated hypothyroidism in the reproductive age group can affect menstrual health, fertility, pregnancy outcomes, and metabolic balance, making this demographic vulnerable. Late diagnosis and inadequate illness management are widespread in Bihar, where thyroid illnesses are difficult to diagnose and cure [3]. This emphasises the necessity for hospital-based research on hypothyroidism's biochemical interactions with other metabolic indicators including serum uric acid and its frequency and patterns.

The thyroid gland produces metabolically important hormones T4 and T3. The heart, kidneys, and liver are among the many body systems these hormones affect [4]. Hypothyroidism, characterised by low T3 and T4 levels and excessive TSH, causes many metabolic problems [5]. These problems

include dyslipidaemia, glucose metabolism, oxidative balance, and renal clearance .An intriguing notion in recent years is that hypothyroidism affects purine metabolism and blood uric acid levels [6]. Gout and renal illness are the usual suspects for increased serum uric acid levels, which come from purine metabolism. But it's becoming clear that it indicates oxidative stress, cardiovascular risk, and metabolic dysfunction [7]. Uric acid metabolism and thyroid diseases are intricately linked. Hypothyroidism inhibits the kidneys' uric acid filtering, causing hyperuricemia. Hypothyroidism-related oxidative damage and inflammation may also affect purine metabolism [8]. Researchers have also found that thyroid hormones may affect xanthine oxidase, which produces uric acid. High serum uric acid levels may indicate hypothyroidism, which raises the risk of cardiovascular disease and metabolic syndrome [9]. Even though this makes biological sense, investigations have found inconsistent findings. Serum uric acid levels and TSH in hypothyroid patients have been linked in some studies, whereas others have found no association or different patterns dependent on gender, comorbidities, or hypothyroidism severity [10].

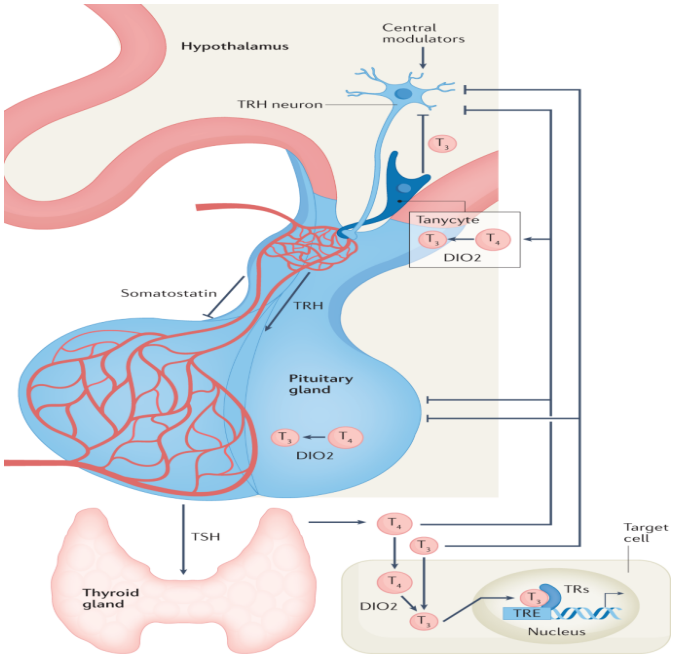

Figure 1: **Hypothyroidism (Source:[11])**

The thyroid dysfunction-uric acid metabolism relationship is clinically significant for women. Women with hypothyroidism may have weight gain, irregular periods, and decreased physical activity, which can affect uric acid levels[12]. In postmenopausal hypothyroid women, hyperuricemia may increase cardiovascular disease risk. Therefore, studying this connection in females is clinically advantageous to increase preventative efforts and significant for research.

Multiple hospital and community studies in India have examined hypothyroid individuals' biochemical profiles. Many studies have examined autoimmune indicators, glucose homeostasis, and lipid abnormalities, but few have examined thyroid profile and uric acid levels.

In Bihar, few research has studied this association, especially with women .Learning about these biochemical correlations may be a cost-effective strategy to identify at-risk patients and enhance patient care, especially in Bihar, which has many thyroid issues but few healthcare resources. The vast patient base of ESIC Bihta makes it suited for this type of study.

Another important consideration is the study's longitudinal design. Cross-sectional research on hypothyroid patients have only provided a glimpse into their metabolic status. A hospital-based longitudinal study is excellent to explore how thyroid hormone levels affect biochemical indicators like blood uric acid over time. This improves our understanding of pathophysiological mechanisms and strengthens the causal link.

This study aims to fill a critical literature gap .By researching female primary hypothyroidism patients who attended ESIC Bihta from July 2023 to April 2025, we hope to give regionally and clinically relevant information .Our longitudinal study will examine their thyroid and blood uric acid levels.

Objectives of the Study

1. To evaluate the serum uric acid levels among female patients diagnosed with primary hypothyroidism.
2. To assess the thyroid profile (TSH, freeT3, freeT4) among the female patients diagnosed with primary hypothyroidism
3. To determine the correlation among serum uric acid levels and thyroid hormone parameters.
4. To analyze whether serum uric acid can serve as a supportive biochemical marker for disease monitoring and prognosis in hypothyroid patients.

By fulfilling these objectives, with this research, we hope to contribute more accurate information to what is already known about how thyroid dysfunction affects the metabolism of purines. The findings could also provide a basis for considering serum uric acid as part of the routine biochemical evaluation in female hypothyroid patients, thereby supporting early intervention strategies and improving long-term outcomes.

Materials and Methods

Study Design: In this study, female patients with primary hypothyroidism were studied as part of hospital-based longitudinal research to regulate if there was a connection among blood uric acid and thyroid profile. A longitudinal framework was chosen in order to capture temporal variations and allow for a more robust analysis of the biochemical relationship between thyroid hormone levels and uric acid concentrations over the study period.

Study Setting: Researchers from the ESIC Hospital, Bihta, Bihar, which provides to a large and diverse population of insured workers and their families. The hospital provides specialized diagnostic and therapeutic services, making it an appropriate setting for biochemical and clinical evaluation of endocrine disorders such as hypothyroidism.

Study Duration: From July 2023 to April 2025, worked on the project. During this time, consecutive eligible patients presenting to the outpatient and inpatient departments of the hospital were screened and enrolled.

Sample Size: A total of 300 female patients with primary hypothyroidism were included in the study.

This sample size was considered adequate to detect clinically relevant correlations between serum uric acid and thyroid hormone parameters, while also providing sufficient statistical power for subgroup analyses.

Inclusion Criteria

- Female patients between 18 and 60 years of age.
- Patients diagnosed with primary hypothyroidism based on elevated serum TSH and reduced free T3/free T4 levels.
- Both newly diagnosed patients and those already receiving levothyroxine therapy were included to ensure representation of different stages of disease.

Exclusion Criteria

- Patients with renal diseases or history of gout, as these conditions independently alter uric acid metabolism.
- Patients with secondary hypothyroidism resulting from pituitary or hypothalamic pathology.
- Patients taking medications known to influence uric acid levels, such as diuretics, allopurinol, or uricosuric drugs.
- Pregnant women, due to physiological changes in thyroid function and uric acid levels during pregnancy.

Data Collection: All patients were interviewed and clinically examined at the time of enrolment. Data were collected using a structured Performa, which included the following parameters:

1. **Demographic details** – age, socioeconomic status, and Body Mass Index (BMI).
2. **Serum uric acid levels** – measured at baseline and subsequent visits during the study period.
3. **Thyroid profile** – including serum Free T3, free T4, and total steroid hormone (TSH). These were evaluated to establish hypothyroidism and evaluate its correlation with uric acid levels.

Laboratory Methods: After an overnight fast, all individuals had aseptic blood sample the next morning. After 10 minutes of centrifugation at 3000 rpm, serum was analysed immediately. An automated biochemistry analyzer (Vitros 350 Dry Chemistry) tested serum uric acid using the uricase-peroxidase enzymatic technique. Using chemiluminescence immunoassay (CLIA), thyroid profile parameters (TSH, fT3, and fT4) were estimated on the Vitros ECI analyzer. Assays were performed according to the manufacturer's standard operating procedures, and internal and external controls were applied to maintain quality and ensure reproducibility.

Ethical Approval: The ESIC Bihta Institutional Ethics Committee examined and authorised the study protocol prior it proceeding. While discussing the study's goals, methods, risks, and benefits with each participant, researchers succeeded in obtaining their written understanding consent. In the study, they made sure that all information about patients remained confidential.

Statistical Analysis: Data was compiled, entered, and analysed using SPSS (IBM Corp., Armonk, NY, USA). The baseline demographic and biochemical variables were summarised using descriptive statistics such as median, percentages, and mean ± SD. Pearson's correlation coefficient is utilised for normally distributed variables and Spearman's rank correlation coefficient for non-parametric variables to analyse the connection between serum uric acid and thyroid profile (TSH, fT3, fT4).

A p-value below Statistical significance was indicated by a p-value below 0.05.

Scattered plots, tables, and charts were used to display the results for simplicity of comprehension.

Results

Demographic Profile of Participants: A total of 300 female patients with primary hypothyroidism were included in this hospital-based long-term research. The average age of the participants was 38.7 ± 9.4 years, and the median age ranged around 18 to 60 years. Of the total patients, 42.3% were between the ages of 31 and 40, with 28.7% occurring between the ages of 41 and 50. The mean BMI of the study population was 27.1 ± 3.8 kg/m², with 62% of participants classified as overweight or obese according to WHO Asian criteria. Most participants belonged to middle socioeconomic status groups, consistent with the patient profile at ESIC Bihta.

Table 1: Baseline Characteristics of Study Participants

Variable	Mean ± SD / n (%)
Age (years)	38.7 ± 9.4
Age Distribution	18–30: 86 (28.7%) 31–40: 127 (42.3%) 41–50: 86 (28.7%) >50: 21 (7.0%)
BMI (kg/m²)	27.1 ± 3.8
Overweight/Obese (≥25)	186 (62.0%)
Socioeconomic Status	Lower: 92 (30.7%) Middle: 158 (52.7%) Upper: 50 (16.6%)

Baseline Thyroid and Uric Acid Levels: At baseline, the mean serum TSH level was 10.8 ± 4.7 µIU/mL, while mean fT3 and fT4 levels were 2.1 ± 0.6 pg/mL and 0.7 ± 0.2 ng/dL, respectively, consistent with biochemical hypothyroidism. The mean serum uric acid level was 6.1 ± 1.4 mg/dL, with 34% of patients showing hyperuricemia (>6.5 mg/dL in females).

Table 2: Baseline Thyroid Profile and Serum Uric Acid Levels

Parameter	Mean ± SD	Reference Range (Female)
TSH (µIU/mL)	10.8 ± 4.7	0.4 – 4.0
Free T3 (pg/mL)	2.1 ± 0.6	2.3 – 4.2
Free T4 (ng/dL)	0.7 ± 0.2	0.8 – 1.8
Serum Uric Acid (mg/dL)	6.1 ± 1.4	2.5 – 6.5

Correlation Analysis: They examined the relationship between thyroid hormone parameters and blood uric acid using Pearson's correlation coefficient. A significant positive correlation exists between TSH levels and serum uric acid levels ($r = +0.42$, $p < 0.001$). Both fT3 ($r = -0.31$, $p = 0.002$) and fT4 ($r = -0.28$, $p = 0.004$) were negatively linked with serum uric acid, indicating decrease thyroid hormone levels were associated with higher uric acid concentrations. The correlation matrix is shown in Table 3.

Table 3: Correlation Matrix of Serum Uric Acid and Thyroid Parameters

Parameter	TSH (µIU/mL)	fT3 (pg/mL)	fT4 (ng/dL)	Serum Uric Acid (mg/dL)
TSH	1.0	–0.46*	–0.42*	+0.42*
Free T3	–0.46*	1.0	+0.39*	–0.31*
Free T4	–0.42*	+0.39*	1.0	–0.28*
Serum Uric Acid	+0.42*	–0.31*	–0.28*	1.0

***p < 0.05 (statistically significant)**

Subgroup Analysis: When divided into two groups: newly diagnosed (n = 162) and levothyroxine users (n = 138), differences were found. Compared to individuals undergoing

treatment, newly diagnosed patients had higher mean uric acid (6.4 ± 1.5 mg/dL) and TSH (12.4 ± 5.2 µIU/mL) levels. Both groups exhibited a significant correlation between uric acid and TSH, but newly diagnosed patients had a stronger correlation ($r = +0.48$, $p < 0.001$) than under-treatment patients ($r = +0.36$, $p = 0.002$).Newly diagnosed patients had stronger negative correlations with fT3 and fT4, suggesting that thyroid hormone replacement therapy reduces the effects of hypothyroidism on uric acid metabolism.

Discussion

This hospital-based longitudinal study at ESIC Bihta demonstrated a substantial correlation among thyroid profile and blood uric acid in female primary hypothyroidism patient's .Free T3 and Free T4 had negative associations with serum uric acid, while TSH had a positive one.

Increasing thyroid dysfunction appears to promote purine metabolism alterations that raise uric acid levels. Thyroid hormone supplementation may reduce metabolic problems; subgroup study showed that newly diagnosed patients had bigger associations than those already receiving treatment.

Comparison with Previous Studies: The findings are consistent with Indian and international research on the biochemical relationship between hypothyroidism and uric acid metabolism. TSH is positively correlated with uric acid, and Study 1 showed the blood uric acid levels of thyroid dysfunction individuals were significantly higher than euthyroid controls in North India .Study 2 discovered that hypothyroid women, especially untreated ones, had higher hyperuricemia. Previous South Indian research supports this result. Study 3 found a similar correlation in China, where hypothyroid individuals had higher serum uric acid and impaired renal clearance. Western studies, notably those including European cohorts, have found weaker or inconsistent associations, possibly due to genetics, dietary habits, or metabolic syndrome prevalence. Lifestyle factors like diet and obesity and the high baseline frequency of hypothyroidism in Indian women may explain the increased connections in our study group.

Table 4: Previous Research and the Current Study

Study	Setting & Sample Size	Key Findings
Study 1[13]	Cross-sectional study, 150 hypothyroid patients (60% female)	Reported significantly higher serum uric acid in hypothyroid patients compared to euthyroid controls; positive correlation between TSH and uric acid.
Study 2[14]	Hospital-based, 200 female hypothyroid patients	Found higher prevalence of hyperuricemia in untreated hypothyroid patients; uric acid levels decreased after levothyroxine therapy.
Study 3 [15]	Community-based, 320 adults with hypothyroidism	Observed reduced renal clearance as main mechanism; moderate positive correlation between TSH and uric acid, negative with free T3.
Present Study (ESIC Bihta, July 2023 to April 2025)	Longitudinal hospital-based, 300 female patients	The average uric acid level was 6.1 ± 1.4 mg/dL, and there was a positive association with TSH ($r = +0.42$, $p < 0.001$). On the other hand, there was a negative correlation with fT3 and fT4, and the connections were greater in initially diagnosed.

Pathophysiological Mechanisms: Multiple metabolic factors underlie the association. Due to decreased glomerular filtration rate and renal plasma flow, hypothyroidism can cause hyperuricemia. Dyslipidaemia, insulin resistance, and enhanced oxidative stress in hypothyroid patients may also affect purine metabolism. Thyroid hormones regulate xanthine oxidase activity; therefore reduced hormone levels may enhance enzyme activity and uric acid production. The negative associations of uric acid with fT3 and fT4 in this study support these pathophysiological links.

Limitations: The results of this study are intriguing, but there are several drawbacks. The three-month, one-location study may not apply to a wider population. Because hypothyroidism is more common in women, this study only included them. We cannot directly apply the results to male populations. Without follow-up beyond three months, we could not determine the effect of long-term thyroid hormone replacement on uric acid levels. Finally, physical activity, genetic predispositions, and purine intake were not considered confounding factors.

Strengths of the Study: In spite of these cautions, the research does have a number of strong points. Statistical power was adequately ensured by the relatively large sample size of 300 patients for a hospital-based investigation. In the Indian setting, where thyroid diseases are more common in women, the gender-specific insights gained from focussing on a female cohort are especially significant. This study adds to the little literature on the biochemical features of thyroid dysfunction by providing data relevant to the Bihar region. Thyroid hormone and uric acid levels were reliably and reproducibly measured since the study used a

longitudinal design and standardised laboratory methodologies.

Conclusion

This ESIC Bihta hospital-based longitudinal study of 300 female primary hypothyroidism patients found a statistically significant connection between blood uric acid and thyroid profile data. The link between blood uric acid levels and TSH was positive and free T3 and free T4 were negative; this association was stronger in newly diagnosed patients than in those receiving levothyroxine .The most plausible explanations are oxidative pathway alterations and impaired renal clearance, which link thyroid function to uric acid metabolism. Since blood uric acid is cheap, frequently available, and requires no special equipment, it may be useful as an added biochemical diagnostic for hypothyroid patients, especially in low-resource countries. Hypothyroidism and hyperuricemia increase metabolic and cardiovascular risks; hence regular uric acid testing may improve patient management. To strengthen the evidence, larger multicentric studies with longer follow-up periods should validate and expand on the results.

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