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Research Article

STUDY TO ASSESS SERUM FERRITIN LEVELS, LIPID PROFILE, AND THYROID PROFILE IN HYPOTHYROID PATIENTS

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ABSTRACT

Objective: This study aims to evaluate thyroid hormone levels, lipid profiles, and serum ferritin concentrations in hypothyroid patients, exploring the interplay between iron deficiency, thyroid function, and lipid metabolism.

Methods: A descriptive study was conducted at Gandhi Medical College, Secunderabad, from 2019 to 2021, with 50 hypothyroid patients (aged 25–45 years) and 100 healthy controls. Blood samples were collected after 8–10 h of fasting and analyzed for thyroid hormones, ferritin, and lipid profiles. Statistical analysis was performed using EpiInfo software, with $p<0.05$ considered significant.

Results: The study revealed significantly elevated thyroid-stimulating hormone levels (13.4±10.2 mIU/l) and reduced Triiodothyronine (T3) (0.81±0.31 nmol/dL) and Thyroxine (T4) (4.4±0.93 µg/dL) levels in hypothyroid patients compared to controls ($p<0.05$). The serum ferritin levels were markedly lower in hypothyroid patients (16.9±13.9 ng/mL) than in controls (43.3±19.9 ng/mL), with 68% of cases showing ferritin deficiency. Dyslipidemia was prominent, with higher total cholesterol, triglycerides, low-density lipoprotein (LDL), and very LDL levels and reduced high-density lipoprotein in cases compared to controls ($p<0.05$).

Conclusion: Hypothyroid patients exhibit significant ferritin deficiency and dyslipidemia, highlighting the interconnectedness of iron status, thyroid function, and lipid metabolism. Addressing iron deficiency in hypothyroid patients may improve thyroid function and overall metabolic health.

Keywords: Hypothyroidism, Ferritin, Triiodothyronine, Thyroid-stimulating hormone.

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INTRODUCTION

Thyroid disease affects people worldwide, with hyperthyroidism and hypothyroidism often occurring, especially during pregnancy and childhood [1]. Low free Thyroxine (FT4) levels combined with high thyroid-stimulating hormone (TSH) occur in about 0.3% of cases, while low thyroid hormone is seen in around 4.3% [2]. Although hypothyroidism can be easily diagnosed and treated, untreated cases, particularly severe ones, may lead to life-threatening complications [3]. This condition tends to run in families, affects women more often than men, and worsens with age [4]. Some of the common symptoms include depression, fatigue, cold intolerance, mild weight gain, dry skin and hair, irregular menstrual cycles, and reduced bowel movements. However, individuals typically experience only one or two of these symptoms. Hypothyroidism affects about 4–5% of people in developed countries [5,6], while in India, the condition impacts around 10% of the adult population [7], with a total of approximately 42 million individuals suffering from thyroid disorders [8,9].

Around 43% of patients with hypothyroidism also suffer from anemia, a stark contrast to the general population [10]. Iron deficiency anemia, affecting about 15% of the global population, is the most common single-nutrient deficiency worldwide [11]. Erdogan *et al*. found that anemia prevalence was 26.6% in subclinical hypothyroidism and 73.2% in overt hypothyroidism, emphasizing the connection between hypothyroidism and anemia [12]. Several studies suggest that iron deficiency contributes to impaired thyroid function, which may further exacerbate hypothyroidism. In addition, significant reductions in ferritin levels, the body's iron-storage protein, have been observed in patients with hypothyroidism [13].

Ferritin, as an iron-storage protein, plays a critical role in thyroid function, and variations in ferritin serum concentrations can reflect thyroid health. The thyroid peroxidase enzyme, responsible for hormone synthesis, requires iron, and a correlation between thyroid profiles and ferritin levels has been proposed [14]. Research, including a study by Erdogan *et al.* indicates that reduced thyroid hormone stimulation of erythroid colony development leads to normocytic anemia, the most common type in hypothyroid patients [12]. In addition, lower levels of thyroid hormones can disrupt cholesterol and lipid metabolism [15].

This study assesses hypothyroid patient's thyroid levels, lipid profiles, and ferritin levels. Since decreased ferritin can lead to iron deficiency anemia, this research also explores how iron deficiency can aggravate hypothyroidism and contribute to dyslipidemia and disturbed lipid metabolism.

METHODS

This descriptive study occurred at Gandhi Medical College in Secunderabad from 2019 to 2021, approved by the Gandhi Institutional Ethics Committee (IEC/GMC/2019/03/13). It involved 150 participants, including 50 patients diagnosed with hypothyroidism. These criteria encompassed individuals who were either previously diagnosed or newly diagnosed with the hypothyroid disorder. The study also included patients who were on medication, those with irregular medication usage, and individuals who were not on medication at all. Patients aged 25–45 were recruited from the endocrinology department at Gandhi Hospital, Secunderabad. Exclusion criteria included patients with known iron deficiency anemia, pregnant women, individuals with hepatic disorders, renal disease, or polycystic ovarian syndrome.

A control group of 100 healthy individuals attending regular medical checkups was also included for comparison.

Venous blood was collected after an 8–10-h fast, centrifuged at 3000 rpm for 10 min, and serum was stored at −20°C. Statistical analysis was performed with Microsoft Excel 2010, using EpiInfo software to evaluate differences, with $p<0.05$ considered significant.

RESULTS

The present study revealed several key findings regarding participants' demographic and biochemical profiles, including 50 hypothyroid cases and 100 controls. In both groups, a higher proportion of females was noted, with male-to-female ratios of 1:2.3 in cases and 1:2.8 in controls. In the study involving 50 cases, the demographic distribution was comprised of 15 males and 35 females. In comparison, the control group included 26 males and 74 females (Table 1).

The mean age of the cases was 36.3±6.2 years, and for the controls, it was 37.22±5.88 years. The age group distribution was as follows: 25–30 (12 cases, 16 controls), 31–35 (10 cases, 21 controls), 36–40 (13 cases, 23 controls), and 41–45 (15 cases, 40 controls).

Cases had notably lower serum ferritin levels than controls. The mean ferritin level in cases was 16.9±13.9 ng/mL, whereas, in controls, it was 43.3±19.9 ng/mL, with a difference of 25.2, which was statistically significant ($p<0.05$). In addition, 68% of the cases showed decreased ferritin levels, while all controls exhibited normal TSH levels except for 13 individuals.

Thyroid function tests indicated that hypothyroid patients had significantly higher TSH levels (13.4±10.2 mIU/l) compared to controls (2.7±1.4 mIU/l), with a difference of 10.7 ($p<0.05$). Mean thyroxine (T4) levels were lower in hypothyroid patients (4.4±0.93 mcg/dL) versus controls (5.9±1 mcg/dL), showing a difference of 1.5 mcg/dL ($p<0.05$). In addition, triiodothyronine (T3) levels were significantly reduced in cases (0.81±0.31 nmol/dL) relative to controls (1.9±0.5 nmol/dL), indicating a difference of 1.09 nmol/dL ($p<0.05$) (Table 2).

Cases exhibited significantly higher lipid levels compared to controls. The mean total cholesterol was 196.8±67.2 mg/dL in cases versus 142.4±18.7 mg/dL in controls, a difference of 54.4 mg/dL ($p<0.05$). Triglyceride levels were 139.7±55.2 mg/dL in cases and 91.1±19.9 mg/dL in controls, a difference of 48.6 mg/dL with a $p<0.05$. High-density lipoprotein (HDL) levels were lesser in cases (35.9±10.8 mg/dL) than in controls (44.7±7.0 mg/dL), with a difference of 8.8 mg/dL and a $p<0.05$. Very low-density lipoprotein (VLDL) was higher in cases (27.9±11.04 mg/dL) compared to controls (18.2±3.9 mg/dL), showing a difference of 9.7 mg/dL with a $p<0.05$. Low-density lipoprotein (LDL) levels were also higher in cases (133.0±55.2 mg/dL) than in controls (75.5±21.3 mg/dL), with a difference of 57.5 mg/dL ($p<0.05$).

Nearly all controls had normal TSH and ferritin levels, whereas 96% of cases had elevated TSH levels, with 68% showing reduced ferritin levels. These findings reflect a strong association between hypothyroidism, iron deficiency, and dyslipidemia in the cases.

Table 1: Demographic distribution

Variable	Cases (%)	Controls (%)
Age		
25–30	12 (24)	16 (16)
31–35	10 (20)	21 (21)
36–40	13 (26)	23 (23)
41–45	15 (30)	40 (40)
Gender		
Male	15 (30)	26 (26)
Female	35 (70)	74 (74)

Table 2: Comparison of various parameters between cases and controls

Parameter	Cases	Controls	p-value using t-test
Serum ferritin (ng/mL)	16.9±13.9	43.3±19.9	<0.05
Thyroid-stimulating hormone (mIU/l)	13.4±10.2	2.7±1.4	<0.05
Thyroxine (T4) (µg/dL)	4.4±0.93	5.9±1	<0.05
Triiodothyronine (T3) (nmol/dL)	0.81±0.31	1.9±0.5	<0.05
Total cholesterol (mg/dL)	196.8±67.2	142.4±18.7	<0.05
Triglycerides (mg/dL)	139.7±55.2	91.1±19.9	<0.05
High-density lipoprotein (mg/dL)	35.9±10.8	44.7±7.0	<0.05
Very low-density lipoprotein (mg/dL)	27.9±11.04	18.2±3.9	<0.05
Low-density lipoprotein (mg/dL)	133.0±55.2	75.5±21.3	<0.05

DISCUSSION

Hypothyroidism occurs when the thyroid gland produces inadequate thyroid hormones, which results in metabolic disturbances. Thyroid hormones, particularly T3 and T4 are essential in regulating various bodily functions, including lipid and iron metabolism. Since these hormones are integral to metabolism, their deficiency, as seen in hypothyroidism, results in significant health challenges.

Hypothyroidism is more commonly found in women than in men. Research, such as that by Santin and Furlanetto suggests that this gender disparity might be attributed to estrogen's antagonistic effects on thyroid hormones. Estrogen's interference with T3 and T4 can potentially explain why women are disproportionately affected by thyroid disorders [16].

Thyroid hormones are essential for lipid metabolism. Deficiency can lead to hyperlipidemia, increasing cholesterol, LDL, and triglyceride levels, which raise the risk of atherosclerotic diseases. The present study indicates that serum total cholesterol levels are significantly higher in hypothyroid patients than in healthy individuals ($p<0.001$). This demonstrates a clear association between hypothyroidism and dyslipidemia.

Ferritin, a protein that stores iron in the body, also shows alterations in hypothyroidism. Since iron is critical for thyroid hormone synthesis, decreased ferritin levels can impair thyroid function. This iron-thyroid relationship is reciprocal—iron deficiency can contribute to hypothyroidism, and hypothyroidism can exacerbate iron deficiency. For instance, Das *et al*. demonstrated that heavy menstruation in some women can trigger hormonal changes that eventually lead to hypothyroidism. In this context, ferritin becomes a valuable marker to assess iron status in hypothyroid patients [17].

Measuring ferritin levels in patients with hypothyroidism can provide valuable insights into the possibility of iron deficiency, which may complicate the management of their condition. For example, symptoms such as anxiety, palpitations, and irregular heartbeats may exacerbate with thyroxine treatment if the patient is experiencing iron deficiency. This study indicates a close relationship between iron and thyroid hormone metabolism, suggesting that simultaneous management of both issues could lead to improved treatment outcomes.

The interplay between thyroid hormones, lipid metabolism, and ferritin levels underscores the complexity of hypothyroidism and its broader metabolic implications. Understanding these relationships is crucial for developing comprehensive treatment strategies.

CONCLUSION

This study highlights the relationship between hypothyroidism, iron deficiency, and lipid metabolism. Hypothyroid patients showed elevated TSH and reduced T3 and T4 levels, with 68% exhibiting ferritin deficiency. Dyslipidemia was evident, with increased total cholesterol, triglycerides, LDL, VLDL, and decreased HDL levels compared to healthy controls. These findings indicate that iron deficiency can worsen thyroid dysfunction and metabolic issues. Monitoring ferritin and lipid profiles is essential in hypothyroid patients, as improving iron levels may enhance thyroid function and help manage dyslipidemia.

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AUTHORS CONTRIBUTION

Dr. Patti Anusha Rani collected data, conducted research, and ensured ethical compliance, while also contributing to the study design and result interpretation. Dr. Deva Pragna Prashanthi performed data analysis, prepared the manuscript, and conducted a critical revision. Both authors collaborated on the study's conceptualization, reviewed the final manuscript, and approved it for submission.

CONFLICT OF INTEREST

None as declared.

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