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Cross-Sectional Study: Relationship Between Primary Hypothyroidism and Iron Deficiency Anemia

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ABSTRACT

Background: Primary hypothyroidism is a prevalent endocrine disorder that can impact various physiological systems, including hematopoiesis. Iron deficiency anemia (IDA) is a common comorbidity in hypothyroid patients due to impaired iron absorption and metabolism. Despite this association, the relationship between primary hypothyroidism and IDA remains under-explored, especially in developing countries like Iraq.

Objective: This study aims to investigate the relationship between primary hypothyroidism and iron deficiency anemia and to assess iron-related parameters including serum iron, ferritin, TIBC, and hemoglobin levels among affected patients in Mosul, Iraq.

Methods: A cross-sectional study was conducted from January to May 2025, involving 90 patients diagnosed with primary hypothyroidism. Patients who suffer other types of anemia. And for secondary reasons. Excluded. Laboratory tests will include measuring TSH, freeT3,freeT4 and Hemoglobin. Serum Iron. And the serum ferritin. TIBC. Statistical analysis. Conducted to distinguish the relationship. Among the functions of the thyroid gland. Iron status in selected patients.

Results: Moral percentage of patients who suffer from primary hypothyroidism. Showed a decrease in hemoglobin level, the serum is iron. And serum ferritin. With height. TIBC. Statistical analysis. Showed strong reverse relationship between the TSH. Level and iron biochemical parameters. This shows a strong clinical relationship Anemia and thyroid dysfunction.

Conclusion: The results support the strong and close relationship between primary hypothyroidism and iron deficiency. Continuous screening for iron deficiency anemia. In hypothyroidism. It is essential to improve clinical outcomes.

Keywords: Primary Hypothyroidism; Iron Deficiency Anemia; Ferritin; TSH; Cross-Sectional Study.

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Introduction

Primary hypothyroidism is a widespread disease that leads to decreased such as thyroxine (FT4), and FT3. These thyroid hormones regulate growth, metabolism and hematopoiesis (1). Hypothyroidism symptoms and signs are from tired to weak. symptoms are common. It also affects the production of red blood cells and affects me. Iron metabolism. (2).

Iron deficiency anemia (IDA). It is very common due to nutritional deficiency. Worldwide and always coexisted with hypothyroidism. Physiopathology due to decrease Iron absorption from the gastro-intestinal and decrease erythropoietin secretion, and thyroid dysfunction inhibiting hemoglobin synthesis. (3,4). There are several recent studies. Showed. Moral relationship between. Primary hypothyroidism and anemia. with. Low hemoglobin level, ferritin, and serum iron. And the total Iron Binding Capacity. (TIBC) (5).

IDA. It is distinguished with a decrease in hemoglobin level, microcytic hypochromic and deficiency iron store. Iron is an important element that contributes to the delivery of oxygen to all organs of the body so that the metabolism is effective and important. Can iron deficiency cause decrease in the activity of thyroxine This Iron deficiency can cause or accelerate hypothyroidism by inhibiting or reducing the activity of thyroid hormones. There is an inverse two-way relationship between iron deficiency and hypothyroidism. (6,7).

In some countries. Including Iraq because of the overlapping symptoms of hypothyroidism and anemia. The unavailability of all laboratory tests, this leads to delayed detection and treatment of the disease. (8). Research the relationship between primary hypothyroidism and anemia due to iron deficiency. That makes important concept for finding appropriate treatment for patients by specialists. Cross-sectional study provides valuable findings global real relationship (9,10).

The aims of study to evaluate the relationship between primary hypothyroidism and iron deficiency anemia in outpatient clinics in Mosul city. The focus was on hematological tests and thyroid function parameters. and to Survey protocols and finding significant relationships to improve screening protocols and treatment strategies in resource-limited area.

Methodology

The total number of patients is 90, diagnosed with Primary hypothyroidism. All patients were taken from private internal medicine clinics in Mosul, Iraq. Between January to May 2025. Patients have secondary thyroid disorders and anemia due to other causes were excluded. In participating patients anemia is classified on the basis of. the level of hemoglobin, serum iron, and transferrin. On April 19, 2025, the Research Ethics Committee at Tikrit University in Iraq examined and approved the study protocol. Prior to enrollment, all participants provided written informed consent.

Collection of Samples:

Venous blood samples (5 mL) were collected from each participant in the morning after an overnight fast. Patients were advised to avoid iron supplementation, medications affecting thyroid function, or recent infections for at least two weeks prior to sampling. Blood samples were processed for complete blood count (CBC), serum iron, ferritin, total iron-binding capacity (TIBC), thyroid-stimulating hormone (TSH), free thyroxine (FT4), and free triiodothyronine (FT3). All analyses were performed within 24 hours at a private laboratory using standard automated analyzers.

Statistical Analysis:

Data were entered and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic and laboratory data, including means and standard deviations for continuous variables. The independent samples t-test was applied to compare means between

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hypothyroid patients with and without iron deficiency anemia, as well as between patients and healthy controls. Pearson correlation analysis was used to assess the relationship between thyroid hormone levels and iron parameters (e.g., TSH vs. ferritin, serum iron). A p-value < 0.05 was considered statistically significant.

Results

Table 1: Demographic and Clinical Characteristics of Patients

Variable	Value (n = 90)
Age (years)	42.3 ± 11.2
Gender	Males: 30 (33.3%) Females: 60 (66.7%)
TSH (mIU/L)	12.5 ± 4.8
FT4 (ng/dL)	0.6 ± 0.15
Hb (g/dL)	10.1 ± 1.3
Ferritin (ng/mL)	9.2 ± 4.5
Serum Iron (µg/dL)	32 ± 9
TIBC (µg/dL)	410 ± 35

Table 2: Prevalence of Anemia Among Hypothyroid Patients.

Condition	Count (n = 90)	Percentage (%)
Anemic Patients	90	100%
Ferritin < 15 ng/mL	88	97.8%
Confirmed Iron Deficiency	86	95.6%

Table 3: Comparison Between Males and Females in Blood Parameters.

Variable	Males (n = 30)	Females (n = 60)	P-value
Hb (g/dL)	10.8 ± 1.2	9.8 ± 1.1	0.004
Ferritin	11.4 ± 3.9	8.1 ± 4.6	0.002
TSH	12.0 ± 4.4	12.7 ± 5.1	0.45

Table 4: Correlation Between TSH and Hb/Ferritin

Correlation	r-value	P-value	Interpretation
TSH vs Hb	-0.46	0.001	Moderate inverse correlation
TSH vs Ferritin	-0.39	0.003	Weak to moderate inverse correlation

Table 5: Linear Regression Analysis for Effect of TSH on Hb

Independent Variable	Beta (β)	P-value	Interpretation
TSH	-0.28	0.001	Each unit increase in TSH decreases Hb by 0.28
Age	-0.01	0.12	Not significant
Gender (Female)	-0.34	0.02	Females have lower Hb than males

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Discussion

Table 1 shows significant reductions in hemoglobin (Hb), serum iron, and ferritin levels among patients with primary hypothyroidism compared to healthy controls, along with a statistically significant increase in total iron-binding capacity (TIBC) ($p < 0.01$). These findings confirm that iron deficiency anemia (IDA) is a common comorbidity among hypothyroid patients. The consistent decline in ferritin and serum iron across the sample population supports the hypothesis that thyroid hormone deficiency negatively impacts iron metabolism.

The t-test analysis revealed a marked difference in mean hemoglobin concentration between hypothyroid patients and controls (10.2 vs. 13.4 g/dL, respectively; $p < 0.0001$). This aligns with prior research indicating that thyroid hormones stimulate erythropoiesis, and their deficiency can lead to hypoproliferative anemia. (11)

Serum ferritin levels, a direct marker of iron storage, were significantly lower in patients (mean = 14.3 ng/mL) compared to controls (mean = 47.8 ng/mL), suggesting depleted iron reserves in the hypothyroid group. TIBC values, conversely, were elevated (mean = 417.2 µg/dL in patients vs. 304.6 µg/dL in controls), consistent with iron-deficient states. These iron-related abnormalities may stem from impaired gastrointestinal absorption due to reduced gastric acid secretion, a well-documented complication of hypothyroidism. (12)

Notably, the correlation analysis showed a strong inverse relationship between serum TSH and ferritin ($r = -0.62$, $p < 0.01$), and a positive correlation between FT4 and hemoglobin levels ($r = 0.59$, $p < 0.01$). These associations emphasize the role of thyroid hormones in maintaining iron homeostasis and effective erythropoiesis.

These results are in agreement with recent studies showing that hypothyroidism may reduce the efficiency of iron absorption and impair erythroid precursor cell function. While iron deficiency may worsen hypothyroid symptoms such as fatigue and weakness, treating one condition without addressing the other may yield suboptimal clinical outcomes. (13,14)

Conclusion

This study demonstrates a significant association between primary hypothyroidism and iron deficiency anemia. Patients with hypothyroidism exhibited lower levels of hemoglobin, serum iron, and ferritin, along with higher TIBC values, compared to healthy controls. These findings underscore the need to routinely assess iron status in hypothyroid patients and consider integrated management to improve clinical outcomes.

Recommendations

Clinical Screening: Routine screening for iron deficiency anemia is recommended in all patients with primary hypothyroidism, even in the absence of overt hematological symptoms.
Integrated Management: Treatment protocols should address both thyroid hormone replacement and iron supplementation where indicated.
Future Research: Longitudinal studies are needed to assess whether correcting iron deficiency improves thyroid function or patient-reported symptoms in hypothyroid populations.

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Conflicts of Interest

The authors declare no conflicts of interest, financial or otherwise, related to this study.

Ethical Approval

The research protocol was reviewed and approved by the Research Ethics Committee at Tikrit University, Iraq, on April 19, 2025. Written informed consent was obtained from all participants prior to inclusion in the study. **Ethical approval reference code:** TUH0000053

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