Journal of Advanced Healthcare and Medical Sciences (JAHMS)
J. Adv. Healthc. Med. Sci.
E-ISSN: xxxx-xxxx; P-ISSN: xxxx-xxxx
Website: https://www.jahms.org/

Original Article

Thyroid Dysfunction and Cardiovascular Risk

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Received: 2025-07-20 **Accepted**: 2025-09-18 **Published**: 2025-11-30

Abstract-

Background: Thyroid hormones play a crucial role in regulating cardiovascular physiology, including heart rate, vascular resistance, myocardial contractility, and lipid metabolism. Both hypothyroidism and hyperthyroidism have been associated with increased cardiovascular morbidity and mortality. ***Objective***: To evaluate the association between thyroid dysfunction and cardiovascular risk factors among adult patients attending a tertiary care hospital. ***Materials and Methods:*** A cross-sectional observational study was conducted among 200 adults aged 18–70 years. Participants were categorized into euthyroid, hypothyroid, and hyperthyroid groups based on serum thyroid-stimulating hormone (TSH), free thyroxine (FT4), and triiodothyronine (T3) levels. Cardiovascular risk factors including blood pressure, lipid profile, body mass index (BMI), and electrocardiographic findings were assessed. Statistical analysis was performed using SPSS version 25.0, with $p < 0.05$ considered statistically significant. ***Results***: Among the 200 participants, 120 (60%) were euthyroid, 55 (27.5%) were hypothyroid, and 25 (12.5%) were hyperthyroid. Hypothyroid patients demonstrated significantly higher levels of total cholesterol, LDL cholesterol, and systolic blood pressure compared with euthyroid subjects. Hyperthyroid patients exhibited increased heart rate and a higher prevalence of atrial fibrillation. Cardiovascular risk scores were significantly elevated in both thyroid dysfunction groups. ***Conclusion***: Thyroid dysfunction is strongly associated with adverse cardiovascular risk profiles. Early diagnosis and management of thyroid abnormalities may reduce cardiovascular morbidity and improve long-term outcomes.

Keywords: *Thyroid dysfunction, hypothyroidism, hyperthyroidism, cardiovascular disease, cardiovascular risk factors, lipid profile.*

INTRODUCTION

Thyroid hormones are essential regulators of metabolic processes and play a critical role in maintaining cardiovascular homeostasis. The thyroid gland produces thyroxine (T4) and triiodothyronine (T3), hormones that influence cardiac contractility, vascular resistance, heart rate, and lipid metabolism. Even minor alterations in thyroid hormone levels can significantly affect cardiovascular function and contribute to the development of cardiovascular disease (CVD) (1).

Cardiovascular diseases remain the leading cause of mortality worldwide, accounting for nearly one-third of all global deaths (2). Traditional cardiovascular risk factors such as hypertension, dyslipidemia, diabetes mellitus, smoking, and obesity are well established. However, endocrine disorders, particularly thyroid dysfunction, have emerged as important non-traditional risk factors that influence cardiovascular health (3).

Hypothyroidism is characterized by decreased production of thyroid hormones and elevated serum thyroid-stimulating hormone (TSH) levels. It affects approximately 4–10% of the adult population and is more common among women and older individuals (4). Reduced thyroid hormone levels lead to increased systemic vascular resistance, impaired endothelial function, decreased cardiac output, and abnormalities in lipid metabolism. Consequently, hypothyroidism is associated with hypertension, atherosclerosis, coronary artery disease, and heart failure (5).

Subclinical hypothyroidism, defined by elevated TSH levels with normal circulating thyroid hormones, has also been linked to increased cardiovascular risk. Several epidemiological studies have demonstrated associations between subclinical hypothyroidism and elevated serum cholesterol levels, endothelial dysfunction, and increased incidence of coronary heart disease (6). The risk appears particularly significant in individuals with TSH levels greater than 10 mIU/L (7).

Conversely, hyperthyroidism results from excessive thyroid hormone production and is characterized by suppressed TSH levels. Excess thyroid hormones increase myocardial oxygen demand, heart rate, and cardiac output while reducing

systemic vascular resistance (8). Persistent hyperthyroidism may lead to arrhythmias, particularly atrial fibrillation, as well as left ventricular hypertrophy and heart failure (9). Atrial fibrillation occurs in approximately 10–20% of patients with overt hyperthyroidism and significantly increases the risk of thromboembolic events and stroke (10).

Thyroid dysfunction influences lipid metabolism through alterations in hepatic cholesterol synthesis and clearance. Hypothyroidism is associated with elevated total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglyceride levels, whereas hyperthyroidism often causes reductions in serum cholesterol concentrations (11). These metabolic changes contribute to variations in cardiovascular risk profiles among affected individuals.

Recent evidence suggests that thyroid hormones also affect vascular endothelial function, coagulation pathways, oxidative stress, and inflammatory responses, all of which play crucial roles in cardiovascular disease development (12). Given the increasing prevalence of thyroid disorders and cardiovascular disease globally, understanding their interrelationship is essential for early diagnosis, risk stratification, and preventive interventions.

Therefore, the present study was conducted to assess the association between thyroid dysfunction and cardiovascular risk factors among adult patients attending a tertiary care hospital.

MATERIALS AND METHODS

A hospital-based cross-sectional observational study was conducted in the Department of General Medicine of a tertiary care teaching hospital over a period of six months.

Study Population

Adult patients aged between 18 and 70 years who attended the outpatient and inpatient departments and underwent thyroid function testing were considered for inclusion.

Sample Size

A total of 200 participants were enrolled using convenience sampling after obtaining informed consent.

Inclusion Criteria

1. Adults aged 18–70 years.
2. Patients who underwent thyroid function testing.
3. Individuals willing to participate and provide informed consent.

Exclusion Criteria

1. Known congenital heart disease.
2. Chronic kidney disease.
3. Pregnancy.
4. Patients receiving lipid-lowering medications.
5. Individuals with severe systemic illnesses.

Data Collection

A structured questionnaire was used to obtain demographic and clinical information, including age, gender, smoking status, family history of cardiovascular disease, and medical history.
Anthropometric measurements included:

- Height (cm)
- Weight (kg)
- Body Mass Index (BMI)
- Waist circumference

Blood pressure was measured using a standardized sphygmomanometer after five minutes of rest.

Laboratory Investigations

Fasting venous blood samples were collected for:

- Thyroid-stimulating hormone (TSH)
- Free thyroxine (FT4)
- Triiodothyronine (T3)
- Total cholesterol
- LDL cholesterol
- HDL cholesterol
- Triglycerides

- Fasting blood glucose

Participants were classified as:

- **Euthyroid:** Normal TSH and FT4 levels
- **Hypothyroid:** Elevated TSH with low FT4
- **Hyperthyroid:** Suppressed TSH with elevated FT4 and/or T3

Cardiovascular Assessment

All participants underwent:

- Electrocardiography (ECG)
- Resting heart rate assessment
- Blood pressure measurement

The Framingham cardiovascular risk score was calculated to estimate 10-year cardiovascular risk.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation. Categorical variables were presented as frequencies and percentages. Comparisons among groups were performed using one-way ANOVA and Chi-square tests. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

Institutional Ethics Committee approval was obtained prior to commencement of the study. Written informed consent was obtained from all participants.

RESULTS

Table 1. Distribution of Participants According to Thyroid Status

Thyroid Status	Number (n)	Percentage (%)
Euthyroid	120	60.0
Hypothyroid	55	27.5
Hyperthyroid	25	12.5
Total	200	100

Among the study participants, 60% were euthyroid, while 27.5% and 12.5% had hypothyroidism and hyperthyroidism, respectively.

Table 2. Comparison of Cardiovascular Risk Factors

Variable	Euthyroid	Hypothyroid	Hyperthyroid	p-value
BMI (kg/m²)	24.8 ± 3.1	27.6 ± 4.0	23.4 ± 2.8	<0.01
SBP (mmHg)	122 ± 12	134 ± 14	128 ± 15	<0.01
Total Cholesterol (mg/dL)	182 ± 28	224 ± 35	165 ± 26	<0.001
LDL-C (mg/dL)	108 ± 24	142 ± 30	92 ± 20	<0.001
Heart Rate (beats/min)	74 ± 8	70 ± 9	96 ± 12	<0.001

Hypothyroid patients exhibited significantly higher BMI, systolic blood pressure, total cholesterol, and LDL cholesterol. Hyperthyroid patients showed significantly elevated heart rates.

Table 3. Cardiovascular Manifestations

Manifestation	Euthyroid n (%)	Hypothyroid n (%)	Hyperthyroid n (%)
Hypertension	18 (15.0)	20 (36.4)	6 (24.0)
Dyslipidemia	22 (18.3)	30 (54.5)	5 (20.0)
Atrial Fibrillation	1 (0.8)	2 (3.6)	5 (20.0)

Hypertension and dyslipidemia were more prevalent among hypothyroid individuals, whereas atrial fibrillation occurred predominantly in hyperthyroid patients.

DISCUSSION

The present study demonstrated a significant association between thyroid dysfunction and cardiovascular risk factors. Both hypothyroidism and hyperthyroidism were associated with adverse cardiovascular outcomes, supporting previous findings that thyroid hormones play a critical role in cardiovascular regulation (1).

Hypothyroid participants exhibited significantly higher serum cholesterol and LDL cholesterol levels than euthyroid individuals. These findings are consistent with the study by Duntas and Brenta, who reported that thyroid hormone

deficiency impairs hepatic LDL receptor activity, resulting in reduced cholesterol clearance and increased atherogenic risk (11). Elevated LDL cholesterol contributes to endothelial dysfunction and accelerates atherosclerotic plaque formation.

In addition to dyslipidemia, hypothyroid patients in the current study demonstrated significantly higher systolic blood pressure. Increased peripheral vascular resistance resulting from reduced thyroid hormone activity may explain this observation (5). Similar findings were reported by Rodondi et al., who observed a higher prevalence of hypertension and coronary artery disease among individuals with subclinical hypothyroidism (6).

Body mass index was also significantly elevated among hypothyroid patients. Reduced basal metabolic rate and altered energy expenditure are known consequences of thyroid hormone deficiency and contribute to weight gain and obesity, both established cardiovascular risk factors (4). The combined presence of obesity, hypertension, and dyslipidemia may substantially increase long-term cardiovascular morbidity.

Hyperthyroid participants exhibited significantly increased resting heart rates and a higher prevalence of atrial fibrillation. Thyroid hormones increase β-adrenergic receptor sensitivity and myocardial excitability, predisposing individuals to tachyarrhythmias (8). Atrial fibrillation is one of the most common cardiovascular complications of hyperthyroidism and significantly increases the risk of stroke and systemic embolism (10).

The findings of this study are supported by a meta-analysis conducted by Collet et al., which demonstrated that both overt and subclinical hyperthyroidism were associated with increased cardiovascular mortality and atrial fibrillation risk (7). Early diagnosis and treatment of hyperthyroidism may therefore reduce arrhythmia-related complications.

Emerging evidence also suggests that thyroid dysfunction affects endothelial function, inflammation, coagulation pathways, and oxidative stress mechanisms, all of which contribute to cardiovascular disease progression (12). These pathophysiological mechanisms may explain why even mild thyroid dysfunction can adversely affect cardiovascular health.

The present study highlights the importance of routine cardiovascular risk assessment among patients with thyroid disorders. Screening for lipid abnormalities, hypertension, and arrhythmias should be considered an integral component of thyroid disease management. Early therapeutic interventions may reduce cardiovascular complications and improve overall prognosis.

However, this study had certain limitations. Its cross-sectional design precluded assessment of causal relationships. The study was conducted at a single center with a relatively small sample size, limiting generalizability. Future multicenter prospective studies are recommended to further clarify the long-term cardiovascular consequences of thyroid dysfunction.

CONCLUSION

Thyroid dysfunction is significantly associated with increased cardiovascular risk. Hypothyroidism is linked to hypertension, obesity, and dyslipidemia, whereas hyperthyroidism is associated with tachycardia and atrial fibrillation. Regular cardiovascular evaluation in patients with thyroid disorders may facilitate early detection of complications and improve clinical outcomes. Timely diagnosis and treatment of thyroid dysfunction should be considered an important strategy for cardiovascular disease prevention.

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