Hypothyroidism and Left Atrium

Abramishvili T.[1,2], Esebua L.[2], Papava KH[2].

Abstract

Background: In recent years, there has been growing recognition of the relationship between metabolic disorders and cardiovascular health, but studies remain inconclusive and yield varying results [1,4,8]. By examining the mechanisms through which thyroid dysfunction impacts left atrial dimensions and functionality, clinicians can better understand the broader implications for patient management and treatment strategies [5,8].

Aim: The aim of this study was to perform a systematic literature review on the historical perspective and current evidence regarding hypothyroidism and left atrial dysfunction [1,4,8]..

Methods: The literature review was performed using the PubMed, Cochrane Library, Embase, CNKI, and Sinomed databases to identify clinical studies on the effects of hypothyroidism on cardiac function. The search was limited to articles published in English within the last five years.

Results: Overview of hypothyroidism and its systemic effects. A deficiency in thyroid hormones, as seen in hypothyroidism, leads to systemic effects extending beyond metabolic dysfunction, often impacting cardiovascular health [1,4,6]. The interplay between thyroid hormones and cardiovascular function is particularly critical; low thyroid hormone levels can result in dyslipidemia, endothelial dysfunction, and diminished cardiac contractility, increasing the risk of coronary artery disease and heart failure [2,4,6,14].

Conclusions: Endocrine dysfunction in hypothyroidism significantly complicates cardiovascular outcomes. Thyroid hormones play pivotal roles in cardiac physiology and vascular dynamics [1,2,30]. Proper monitoring is essential in congenital heart disease patients, such as those with transposition of the great arteries, to reduce postoperative complications related to thyroid dysfunction [30]. Routine cardiac evaluation in hypothyroid patients is recommended to manage increased risks of atrial fibrillation and other complications [20–23]. Future research should focus on mechanisms linking thyroid hormone deficiency to left atrial remodeling and the long-term impact of treatment [4]. Early detection of subclinical heart disease induced by hypothyroidism could become a compelling indication for levothyroxine therapy [15]. **TCM-GMJ June 2026; 12 (2): P12-P15)**

Keywords: Hypothyroidism, Heart Failure, Arrhythmias, Left Atrial Function, Left Atrial Phasic Strain.

Introduction

In recent years, there has been growing recognition of the intricate relationship between metabolic disorders and cardiovascular health. Among these, hypothyroidism—a condition characterized by insufficient thyroid hormone production—has increasingly been linked to various cardiac abnormalities, including those affecting the left atrium [1,4,5]. This connection not only highlights the physiological complexities underlying both conditions but also underscores the importance of recognizing this interplay in clinical practice.

Left atrial function and size serve as critical indicators of cardiovascular health, and alterations in these parameters may predispose individuals with hypothyroidism to adverse outcomes such as arrhythmias, heart failure, and stroke [2,6]. By examining the mechanisms through which thyroid dysfunction impacts left atrial dimensions and functionality, clinicians can better understand the broader implications for patient management and treatment strategies.

Ultimately, unraveling this relationship is vital for developing a holistic approach to both hypothyroidism and its cardiovascular consequences. Early detection of cardiac functional or structural changes is crucial for timely intervention [5].

Based on the key roles of thyroid hormones in the car-

From the [1]Ivane Javakhishvili Tbilisi State University, Georgia; [2]Tbilisi Institute of Medicine, Georgia;
Received May 5, 2026; accepted May 28, 2026.
Address requests to: Abramishvili Teona
E-mail: teo2001_ge@yahoo.com

diovascular system, hypothyroidism is known to be associated with the development or progression of various cardiovascular diseases [1,4,7]. Although several previous studies have reported the association between hypothyroidism and heart diseases, a comprehensive analysis of the relationship between hypothyroidism and the left atrium—one of the most important cardiovascular parameters—has not yet been performed.

There are small studies indicating a linear relationship, but most were conducted in populations with other risk factors for left heart disease, such as hypertension or diabetes, which can confound results [8]. Some studies have aimed to comprehensively analyze whether hypothyroidism is associated with left atrial disease. One systematic review of 11 studies found that 10 reported hypothyroidism to be associated with a larger left atrium, while one showed no association. Data quality in all studies was moderate [8]. The association was significant in both Western and Asian populations, and findings remained significant even after rigorous adjustment for hypertension.

However, only population-based studies consistently showed a significant association, indicating that more research is needed to confirm this relationship [8,9]. Furthermore, many studies did not include advanced left atrial functional assessment tools, such as left atrial strain and phasic function evaluation (conduit, reservoir, and pump functions). Currently, assessment of left atrial function is incomplete without these parameters [10].

Left atrial (LA) strain assessment is an important tool in evaluating cardiac function, particularly in patients with atrial fibrillation, heart failure, or other cardiovascular diseases [10–12]. LA strain refers to the measure of how much the left atrium stretches and returns to its normal size after each heartbeat. It serves as a marker of LA stiffness, which can indicate cardiac disease.

Methods

- **Speckle-tracking echocardiography (STE):** Ultrasound imaging tracks the movement of speckles in the myocardium to estimate LA strain.
- **Tissue Doppler imaging (TDI):** Measures the velocity of tissue displacement in the LA to estimate strain.

Cardiac magnetic resonance (CMR) imaging: Provides detailed images of LA structure and function for direct strain measurement.

Studies demonstrate that left atrial strain assessment is valuable for predicting cardiovascular outcomes and guiding management of patients with cardiac disease [11–13].

Results and discussion

Overview of hypothyroidism and its systemic effects A deficiency in thyroid hormones, as seen in hypothyroidism, leads to systemic effects extending beyond metabolic dysfunction, often impacting cardiovascular health [1,4,6]. The interplay between thyroid hormones and cardiovascular function is particularly critical; low thyroid hormone levels can result in dyslipidemia, endothelial dysfunction, and diminished cardiac contractility, increasing the risk of coronary artery disease and heart failure [2,4,6,14].

Research indicates that patients with hypothyroidism often experience symptoms such as fatigue and weight gain, which can further contribute to cardiovascular disorders. Addressing these complications through appropriate therapy—such as levothyroxine (LT4) replacement—is vital. LT4 not only normalizes thyroid hormone levels but also improves lipid metabolism and enhances cardiac performance, demonstrating the importance of thyroid regulation in promoting cardiovascular health [14]. Without timely intervention, the systemic consequences of hypothyroidism can lead to significant complications, particularly affecting cardiac structure and function.

Hypothyroidism is also linked to worse outcomes in patients with diagnosed heart failure [15]. The largest study examining the thyroid–heart disease connection was conducted in Denmark and included 216,894 patients with no known thyroid or heart disease at baseline, each with at least one serum thyroid-stimulating hormone (TSH) measurement between 1995 and 2011 [15]. Data collected over a 7-year period showed that untreated mild hypothyroidism (average TSH 5.5 mIU/L) was associated with an 83% increased risk of developing heart problems compared with individuals with normal thyroid function or treated hypothyroidism. Over a five-year period, untreated mild hypothyroidism tripled the risk of heart problems, while treated hypothyroidism with low TSH had a 2.1-fold increased risk, and treated hypothyroidism with normal TSH had a 1.8-fold increased risk [15]. The highest risk was observed in untreated hypothyroid patients over 65 years of age.

The Relationship Between Hypothyroidism and Cardiac Function Seeking a deeper understanding of how hypothyroidism impacts cardiac function reveals significant insights into the physiological adaptations of the heart in this condition. Research indicates that hypothyroidism can lead to alterations in various cardiac parameters, such as reduced left ventricular ejection fraction and cardiac index, demonstrating that cardiac efficiency is compromised in these patients [16]. Furthermore, the geometric relationship between the left atrium and left ventricle is critical for optimal diastolic filling. In heart transplant patients, for instance, an enlarged left atrium resulting from surgical techniques can lead to impaired diastolic filling due to a negative atrioventricular area difference, revealing how structural changes can detrimentally affect cardiac function [17]. These findings underscore the need for effective treatment strategies, such as aggressive levothyroxine replacement therapy, to restore cardiac performance and enhance overall patient outcomes in those with hypothyroidism or to initiate early treatment for subclinical heart failure.

Low levels of thyroid hormones can negatively affect myocardial morphology and physiology, largely compromising diastolic function [8]. Nevertheless, the degree of dysfunction has not been associated with the development of heart failure but rather exacerbates and worsens this condition [8,18]. A historical cohort study by Ro et al. over 25 years with 52,856 patients found that individuals with hypothyroidism and congestive heart failure had a significantly higher risk of hospitalization due to exacerbation

than euthyroid individuals (hazard ratio 1.86) [18]. In addition, a prospective cohort in the USA with 1365 patients with pre-existing heart failure found that higher TSH levels were associated with more severe heart failure and increased rates of heart transplantation, ventricular assist device placement, and mortality compared to euthyroid patients [19]. The authors concluded that hypothyroidism portends a poorer prognosis in patients with pre-existing heart failure [19].

Atrial Fibrillation and Hypothyroidism Atrial fibrillation (AFib) is a common arrhythmia in individuals with hypothyroidism. The prevalence of AFib varies based on age, severity of hormone deficiency, and comorbidities. Research indicates hypothyroidism may increase AFib risk, especially in older or untreated patients [20–23]. Regular monitoring and effective management of thyroid hormone levels can reduce this risk [20–23].

Impact of Hypothyroidism on Heart Rate and Rhythm The relationship between hypothyroidism and cardiovascular function is complex, particularly regarding heart rate and rhythm. Hypothyroid patients often exhibit bradycardia, leading to impaired cardiac output and increased morbidity. Additionally, hypothyroidism can exacerbate rhythm abnormalities, including atrial fibrillation [24,25]. Changes in left atrial strain correlate with heart rate increases, reflecting the importance of left atrium–left ventricle coupling in cardiovascular stability [24]. Interventions like thoracoscopic radiofrequency fragmentation can improve outcomes in atrial fibrillation and heart failure [25].

Structural Changes in the Left Atrium Due to Hypothyroidism Hypothyroidism can cause structural changes such as fibrosis and atrial remodeling in the left atrium, contributing to arrhythmia development [26,27]. Advanced imaging, including cardiac magnetic resonance, reveals fibrotic lesions correlated with arrhythmic risk [26,27]. Understanding these changes is crucial for targeted therapeutic strategies.

Analysis of Left Atrial Size and Function and Its Implications Left atrial enlargement (LAE) affects patient prognosis and treatment outcomes. Non-linear associations exist between LA diameter and mortality or heart failure hospitalization, with enlargement correlating with increased risks [28]. Low-voltage areas in the left atrial anterior wall can be substrates for arrhythmias, complicating hypothyroid patients' management [29]. Both under- and overtreatment of hypothyroidism may increase heart disease risk, warranting further study [15].

Studies show hypothyroid patients have an increased risk of heart problems compared with euthyroid individuals, regardless of treatment status. Those treated to achieve normal TSH levels have the lowest risk compared to untreated patients or those with low TSH levels. Both undertreatment and overtreatment may be linked to higher cardiac risk, suggesting a need for careful therapy management [15]..

Conclusion

Endocrine dysfunction in hypothyroidism significantly complicates cardiovascular outcomes. Thyroid hormones play pivotal roles in cardiac physiology and vascular dynamics [1,2,30]. Proper monitoring is essential in congenital heart disease patients, such as those with transposition of the great arteries, to reduce postoperative complications related to thyroid dysfunction [30].

Routine cardiac evaluation in hypothyroid patients is recommended to manage increased risks of atrial fibrillation and other complications [20–23]. Future research should focus on mechanisms linking thyroid hormone deficiency to left atrial remodeling and the long-term impact of treatment [4]. Early detection of subclinical heart disease induced by hypothyroidism could become a compelling indication for levothyroxine therapy [15].

1Hypothyroidism may affect cardiac function as an adaptation that could progress to myocardial damage if untreated. Cardiac function often improves with aggressive levothyroxine replacement [8,15].

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