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Original Article

Association between hypothyroidism and metabolic syndrome in a tertiary care hospital

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Abstract

Thyroid disorders are among the most common endocrine conditions, presenting a wide range of biochemical and clinical features with varying degrees of severity. Metabolic syndrome (MetS) consists of a group of abnormalities, including abdominal obesity, insulin resistance, hypertension, hypertriglyceridemia, and reduced high-density lipoprotein cholesterol. Hypothyroidism is linked to hypertension, impaired carbohydrate metabolism, and dyslipidemia, all of which are components of MetS. Both hypothyroidism and MetS frequently occur in clinical practice, and their overlap increases the risk of cardiovascular disease, contributing to higher mortality rates. This study aimed to investigate the association between hypothyroidism and MetS by evaluating the relationships between TSH, FT4, and specific components of MetS. Conducted as a hospital-based case-control study at Chettinad Hospital and Research Institute in Chennai, the study included 50 cases of hypothyroid patients and 50 controls of healthy euthyroid individuals. The presence of MetS was assessed in both groups, with findings revealing that 82% of hypothyroid patients had MetS, compared to 16% of the euthyroid population. In the hypothyroid group, waist circumference (WC) and HDL were significantly associated with TSH (p=0.018 and p=0.029, respectively). Among euthyroid individuals, positive correlations were observed between WC and TSH (p=0.031) and between triglycerides and TSH (p=0.020). Independent sample t-tests revealed statistically significant differences in WC (p=0.004) and fasting blood sugar (FBS) (p<0.001). Additionally, body mass index (BMI) showed a significant difference (p<0.001).

Keywords: hypothyroid, euthyroid, metabolic syndrome.

Introduction

Hypothyroidism has an overall prevalence of 10.95% in the general population, making thyroid disorders one of the most prevalent endocrine conditions [1].

Thyroid dysfunction can be defined based on altered blood TSH levels combined with abnormal or normal levels of T3 and T4. Slow metabolism in subclinical hypothyroidism can result in obesity. To establish the diagnosis of subclinical hypothyroidism, the NCAB has proposed lowering the upper range of TSH to 2.5 MIu/L [2].

Hypothyroidism is related to increased cardiovascular and cerebrovascular morbidity. However, the mechanisms of this are unclear. One of the proposed theories to identify this is the causal association with Metabolic syndrome (MetS) [3].

Syndrome X is the other name for MetS. This lethal quartet is a constellation of interrelated factors like hypertension, central obesity, high triglyceride levels, impaired fasting blood glucose levels and low high-density lipoproteins. The mortality risk in this syndrome is doubled due to various cardiovascular risk factors like Myocardial infarction [4].

In the Indian population, the overall prevalence of MetS is 31.6%, with 39.9% in women and 22.9% in men [2].

Both Thyroid dysfunction and MetS have common abnormalities and act as individual elements that have the potential to cause atherosclerotic cardiovascular disease. Thyroid function influences many metabolic factors. Thyroid function can have a substantial impact on lipoprotein metabolism. Thus, the overall risk for CVD is increased [1].

There is very little research on the connection between metabolic syndrome and thyroid dysfunction. Only a few studies have been conducted to determine their connection and the subsequent effects of their overlap. In a study by Lin St *et al.*, it was discovered that MetS was highly prevalent among patients with thyroid dysfunction. In another study with 220 patients having MetS, the prevalence of subclinical hypothyroidism was 16.4% [5].

Cross-sectional analyses have shown significant risk of CVD in subclinical hypothyroid subjects compared to euthyroid subjects. TSH levels greater than 10 mui/L in SCH were strongly linked with increased incidence and prevalence of MetS [1].

In a study published by CURES, the prevalence of hypertension was estimated to be 20% in an urban Chennai population. The prevalence of individual elements of MetS was assessed amongst the population. Hypertriglyceridemia was found in 38% of the population, with abdominal obesity accounting for 64.3% of the total, general obesity at 40%, diabetes at 31.8%, and hypercholesterolemia at 38.8%.

According to the Jaipur heart monitor research, the age-adjusted prevalence of MetS in Indian urban populations was 24.9%, with 30.9% In women and 18.4% in men. SCH and overt-hypothyroidism have also been recognized as dangerous elements for the development of cardiovascular disease, low-level inflammation, hypercoagulability, and hyperlipidemia, according to the report. Since hypothyroidism and MetS are individualistic risk elements of the mentioned diseases, patients having both these disease conditions have an aggravated risk [6].

Pathogenic processes of CVD can significantly overlap with those of MetS and hypothyroidism. The basic pathogenic mechanism in MetS was studied as insulin resistance. Recent research has looked into the function of insulin resistance in the evolution of hypothyroidism. This relationship can pave the way to a significant overlap among patients with hypothyroidism and MetS.

A Study on the relationship between Metabolic syndrome and thyroid dysfunction can help us determine the depth of overlay among both populations and can emphasize the significance of identifying MetS in hypothyroidism.

This paves the way for effective management and planning modalities to be formulated. Routine screening and early detection of metabolic syndrome in hypothyroid patients can significantly reduce cardiovascular morbidity and mortality and various other complications that arise due to the overlap of MetS and hypothyroidism [7].

The objective of this study is to explore the association between metabolic syndrome (MetS) and hypothyroidism. Specifically, the study aims to determine the relationship between TSH levels and individual components of metabolic syndrome, as well as the correlation between FT4 levels and the manifestation of metabolic syndrome symptoms in individuals.

Material and methods

Sample size and participant criteria

The total sample size for the study is 100 participants. This includes 50 patients with a known diagnosis of hypothyroidism, categorized as the case group, and 50 healthy euthyroid individuals who served as controls.

Inclusion criteria

Participants were selected based on the following criteria:

- Age between 20 and 75 years, inclusive of both sexes;
- Individuals currently undergoing therapy for hypothyroidism;
- Willingness to volunteer for the study;
- Healthy individuals without hypothyroidism were included as the control group;

Exclusion criteria

The following criteria led to exclusion from the study:

- Individuals younger than 20 years or older than 75 years;
- Pregnant women;
- Patients with congestive heart failure;
- Those with renal or liver disorders;
- Severely ill patients.

Study population and methodology

Cases were recruited from Chettinad Hospital and research institute from the inpatient and outpatients who support the above-mentioned criteria for inclusion and exclusion. Fifty patients with hypothyroidism were included in the study group, and 50 healthy controls without thyroid disorders were included as controls to be compared against the study group. Euthyroidism was defined as normal levels of TSH (034–4.5 uiu/ml) Moreover, FT4 (0.58–1.64 ng/dl) and hypothyroidism were defined as TSH levels above 10 uiu/ml and FT4 levels <0.58 ng/dl. We collected information on the patient's history of hypothyroidism, treatment options, and the existence of coexisting conditions such as DM and HTN. Height, weight, and waist circumference were measured anthropometrically. and noted. Standard measuring tape was used to take measurements. Blood pressure was recorded with a mercury sphygmomanometer. Eight hours of fasting were followed by the collection of a blood sample. to determine fasting lipid profile. Thyroid profile values were determined by the CLIA method. Fasting serum levels of TGL were determined using the TGL method, HDL was measured using the auto AHDL method, and cholesterol was determined using the CHOL method. Blood sugar levels were estimated using the GLUC method.

All biochemical tests were conducted in the central clinical biochemistry laboratory, CHRI. Metabolic syndrome in the case and control groups were determined using Modified "NCEP-ATP III criteria (3 out of 5 criteria positive)":

1. BP: ≥130/85 mmHg (or) using antihypertensives.
2. FBS: ≥100 mg/dl (or) having diabetes;
3. TGL: ≥150 mg/dl (or) under treatment;
4. HDL: <40 mg/dl for men, <50 mg/dl for women (or) using Rx;
5. WC: ≥90 cm for men and ≥80 cm for women.

Results

Descriptive statistics were used to determine cases' and controls' mean and standard deviation. It is expressed as Mean±SD (Table 1).

Independent sample t-test was done to compare the values between case and control. A p-value <0.05 was considered statistically significant. There was a statistically significant difference in BMI, FBS and WC values with p<0.001, p<0.001 and p=0.004, respectively (Table 2).

Pearson's correlation was done to determine the correlation between the metabolic syndrome parameters with TSH and FT4. In the hypothyroid group, there was a positive correlation between WC and TSH with p=0.018 and a negative correlation between HDL and TSH with p=0.029. In the euthyroid group, there was a positive correlation between WC and TSH with p=0.031 and between TGL and TSH with p=0.020. There was no significant correlation between MetS parameters and FT4 levels (Table 3).

The prevalence of metabolic syndrome among the hypothyroid group was 82%, and the prevalence was 16% in the euthyroid group. This indicates that there is a uniform pattern of increased prevalence of MetS components. Among the hypothyroid individuals with MetS, 63.4% were females, and 36.6% were male. There was an equal prevalence of metabolic syndrome for both females and males in the euthyroid population. Among hypothyroid individuals without MetS, there were 37.5% females and 75% males. 45.3% of euthyroid females and 54.7% of euthyroid males did not have metabolic syndrome (Table 4).

When the distribution of the specific elements of MetS was studied, it was observed that most of all the parameters were elevated in the Hypothyroid Group compared to the Euthyroid Group. In the Hypothyroid

Table 1: Descriptive statistics of study parameters.

		Mean±Std. Deviation
AGE	Case	48.90±15.20
	Control	47.14±15.12
BMI	Case	25.88±1.43
	Control	24.12±1.43
FBS	Case	131.86±55.28
	Control	103.98±35.83
SBP	Case	130.64±16.31
	Control	119.88±14.48
DBP	Case	79.14±12.22
	Control	76.54±10.30
WC	Case	99.68±8.71
	Control	97.62±8.36
HDL	Case	40.36±9.62
	Control	44.36±12.01
TGL	Case	138.76±69.82
	Control	135.76±66.72

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Table 2: Independent sample t-test.

Parameter	Hypothyroid		Euthyroid		P-value
	Mean	SD	Mean	SD	
BMI	25.8840	1.43219	24.1200	1.43527	<0.001
FBS	131.8600	55.28886	103.9800	35.83550	<0.001
SBP	130.6400	16.31046	119.8800	14.48101	0.253
DBP	79.1400	12.22578	76.5400	10.30793	0.231
WC	99.6800	8.71415	97.6200	8.36877	0.004
HDL	40.3600	9.62302	44.3600	12.01659	0.069
TGL	138.7600	69.82034	135.7600	66.72807	0.827

group, 72% had Elevated WC, 38% had elevated TGL levels, 62% had elevated HDL levels, 36% had elevated BP, 72% had elevated FBS levels, and 82% had higher BMI (Table 5).

Discussion

Our study shows that hypothyroid patients have a higher waist circumference, 72% hypothyroid as compared to euthyroid patients with 20%. This proves a linear relationship between TSH levels and WC. This is in line with the research done by Ramachandran *et al.*, where WC was increased in 31.4% of the study population [8].

In our study, 82% of hypothyroid patients were overweight as compared to euthyroid patients, with 20% overweight. This shows that BMI increases with TSH level. In research done by Solanki *et al.*, it was observed that there is an increase in TSH levels with an increase in BMI. In another study by Kouidhi *et al.*, BMI and TSH had a direct association [9].

Our study shows that 38% of the hypothyroid patients have hypertriglyceridemia. In research done by Karthick *et al.*, TGL levels were higher in subclinical hypothyroid patients. In another study by Roef *et al.*, TGL was positively associated with TSH [10]. In this study, reduced HDL levels were found in 62% of the hypothyroid population as compared to only 38% in the euthyroid population. This shows that increased TSH

Table 3: Pearson's correlational analysis of MetS parameters with TSH levels and FT4 levels.

MetS parameter		Hypothyroid		Euthyroid	
		TSH	FT4	TSH	FT4
WC	R-value	0.167 *	-0.153	0.153 *	0.002
	P-value	0.018	0.290	0.031	0.991
FBS	R-value	0.015	0.015	-0.036	-0.085
	P-value	0.918	0.918	0.803	0.556
SBP	R-value	-0.079	-0.079	0.035	-0.012
	P-value	0.587	0.587	0.811	0.936
DBP	R-value	0.036	0.036	-0.153	0.037
	P-value	0.802	0.802	0.290	0.796
HDL	R-value	-0.308 *	-0.115	0.022	-0.275
	P-value	0.029	0.427	0.881	0.053
TGL	R-value	0.022	0.001	0.329 *	-0.199
	P-value	0.880	0.994	0.020	0.165

Note: * – Statistical significance at the level of 0.05%.

Table 4: Distribution of metabolic syndrome among subjects.

Metabolic syndrome	Group	Female		Male	
		N	%	N	%
Present	Hypothyroid (82%)	26	63.4	15	36.6
	Euthyroid (16%)	4	50	4	50
Absent	Hypothyroid (18%)	3	37.5	6	75
	Euthyroid (84%)	19	45.3	23	54.7

Table 5: Distribution of specific elements of MetS in hypothyroid and euthyroid patients.

Elevated parameter	Total no. of patients		Percentage	
	Hypothyroid	Euthyroid	Hypothyroid	Euthyroid
WC	36	20	72%	40%
TGL	19	18	38%	36%
HDL	31	25	62%	50%
BP	18	7	36%	14%
FBS	36	13	72%	26%
BMI	42	10	82%	20%

is directly linked to reduced HDL levels. In research done by Roef *et al.*, a negative relationship between HDL-c and TSH was observed [11].

In our study, elevation of BP was observed in 36% of the hypothyroid patients as compared to only 14% in euthyroid patients. This also suggests that Diastolic and systolic blood pressure can increase with TSH levels. In a study by Oh *et al.*, SBP and DBP were positively associated with TSH. In another study by Sieminska *et al.*, Higher SBP and DBP were observed in Subclinical hypothyroid patients [12]. In another research by Ramachandran *et al.*, it was reported that HDL <40 mg in urban Asian adults is about 65.5% [8].

Our study reveals that 72% of the hypothyroid population had elevated FBS levels as compared to only 26% in the euthyroid population. This shows a direct association between TSH and insulin resistance. In an investigation by Vamshidhar IS *et al.*, a positive relationship between TSH and FBS and also HbA1c was observed [13].

In our study, 82% of hypothyroid individuals had MetS, and 16% of the euthyroid individuals had MetS. This shows a positive relationship between MetS and TSH levels. This was in accordance with the research by Achida *et al.*, who observed that MetS with three or more components was found in 84% of the study population [14].

The limitations of this study include several factors that may have influenced the findings. Firstly, the small sample size could affect the observed higher incidence of metabolic syndrome (MetS) in hypothyroid patients compared to the general population. Additionally, both hypothyroidism and MetS share similar pathophysiological pathways and clinical features, such as insulin resistance, which may blur the distinction between the two conditions. While previous studies have explored MetS incidence in the general population, this study focused specifically on hypothyroid patients. As a result, individuals with hypothyroidism may have been classified as MetS cases due to overlapping clinical symptoms.

Conclusion

According to our study, it is clearly evident that there is an association between hypothyroidism and metabolic syndrome. Patients with hypothyroidism possess a 2 to 5-fold greater likelihood of developing MetS. Although there was not a statistically significant difference in all the components of MetS, there was a consistent upward trend in the prevalence of all MetS parameters in the hypothyroid group. Therefore, the potential presence of MetS should be kept an eye on in

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hypothyroid patients. Earlier intervention and therapeutic interventions in hypothyroid patients can prevent the happening of major cardiac events.

Conflict of interest

The authors declare no conflict of interest.

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