e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.10.69

International Journal of Pharmaceutical Quality Assurance 2025; 16(10); 438-442

Original Research Article

Assessment of Thyroid Dysfunction among Patients with Metabolic Syndrome

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Received: 10-09-2025 / Revised: 28-09-2025 / Accepted: 26-10-2025

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Conflict of interest: Nil

Abstract:

Background: Metabolic syndrome (MetS) comprises a constellation of cardiometabolic risk factors that elevate the probability of developing type 2 diabetes and cardiovascular disease. Thyroid hormones play a pivotal role in metabolism, and thyroid dysfunction may influence the development and severity of MetS.

Aim: To assess the prevalence and characteristics of thyroid dysfunction in patients with Metabolic Syndrome and its correlation with metabolic markers.

Methodology: A hospital-based cross-sectional study was conducted on 70 adult patients diagnosed with MetS at Nalanda Medical College and Hospital, Patna, India. Anthropometric measurements, blood pressure, fasting blood glucose, lipid profile, and thyroid function tests (T3, T4, TSH) were assessed. The thyroid status was categorized as euthyroid, hypothyroid, or hyperthyroid. Data were examined with SPSS, with $p<0.05$ being significant.

Results: The average age was 52.4 ± 10.2 years; 54.3% were male. Most patients were euthyroid (60%), although hypothyroidism was noted in 34.3% and hyperthyroidism at 5.7%. Individuals with hypothyroidism demonstrated elevated BMI, waist circumference, blood pressure, fasting glucose, and triglyceride levels, and marginally reduced HDL cholesterol, in comparison to euthyroid and hyperthyroid cohorts, signifying a more detrimental metabolic profile.

Conclusion: Hypothyroidism is common in patients with MetS and is associated with worsened metabolic parameters. Routine thyroid function assessment is recommended to optimize management and reduce cardiometabolic risk.

Keywords: Metabolic syndrome, thyroid dysfunction, hypothyroidism, cardiometabolic risk, insulin resistance.

Introduction

Metabolic syndrome, also referred to as MetS, comprises a constellation of cardiometabolic risk factors, including central obesity, insulin resistance, dyslipidemia, and hypertension, which are linked to an increased risk of type 2 diabetes mellitus and cardiovascular disease (1). MetS has been increasing as a global health issue at an alarming rate in the past decades, coinciding with the epidemic of obesity and sedentary lifestyles, especially in the low- and middle-income world. This syndrome is no longer considered to be simply a complex of metabolic disorders but a complicated pathophysiological process involving long-term low-grade inflammation, oxidative stress, and disruption of hormonal balance (2). The thyroid gland, which is one of the endocrine systems that are involved in MetS, has received growing interest in its key role in the regulation of the basal metabolic rate, lipid metabolism, glucose levels, and energy consumption.

Triiodothyronine (T3) and thyroxine (T4) are the crucial hormones that are vital in determining the metabolic functions of cells and the body system. They can impact carbohydrate metabolism, by altering insulin secretion and insulin sensitivity, lipid metabolism, through regulation of cholesterol generation and cholesterol clearance and are vital in the regulation of body weight, by regulating thermogenesis and adipocyte differentiation (3). Even minor changes in thyroid functioning, including subclinical hypothyroidism or changes in plasma levels of thyroid hormones within the normal range, may

have profound metabolic implications. As a result, thyroid malfunction can be involved in the formation and progression of each of the individual elements of MetS, whereas MetS might also negatively impact on the structure and the functioning of the thyroid, which implies a reciprocal interaction (4).

The most common metabolic syndrome has been related to hypothyroidism, both overt and subclinical. The low levels of thyroid hormones are associated with weight gain, excessive visceral adipose tissue, dyslipidemia, high levels of low-density cholesterol and triglycerides, and the inability to metabolize glucose (5). These metabolic disturbances are highly reminiscent of the diagnostic criteria of MetS, and it is therefore possible that thyroid dysfunction could be a contributing factor to the cardiometabolic risk in individuals with these conditions. On the other hand, hyperthyroidism, which is not as widespread as a topic in the MetS, is also capable of affecting glucose intolerance, insulin resistance, and blood pressure regulation, thus emphasizing the complicated relationship between thyroid health and metabolic health (6).

There is some emerging evidence to indicate that insulin resistance, which is a fundamental aspect of MetS, could have a direct effect on thyroid activity in several ways. Hyperinsulinemia has also been suggested to promote the growth of thyroid tissue, which might lead to goiter and nodular thyroid disease (7). Furthermore, adipose tissue hormones and cytokines, including leptin, adiponectin, and pro-inflammatory cytokines, could have an impact on the hypothalamic-pituitary-thyroid axis, changing the release of thyroid hormones and peripheral metabolism (8). MetS is associated with chronic low-grade inflammation that can further affect the action of thyroid hormone at the tissue level further aggravating metabolic dysfunction.

Clinically, the presence of thyroid dysfunction and MetS is a twofold diagnosis and therapeutic concern (9). Thyroid abnormalities in patients with MetS that remain undiagnosed, as well as metabolic control deterioration and cardiovascular risks, may occur, whereas the inability of patients diagnosed with thyroid disorders to recognize MetS may result in the global failure to stratify risk and lead to the management of MetS. Diagnosis of thyroid dysfunction among individuals with MetS especially the obese with dyslipidemia, has thus been recommended by various scholars (10). Yet, there is no consensus about the idea of the regular screening and clinical importance of subclinical thyroid dysfunction in MetS.

Given the increased incidence of metabolic syndrome in the population, and the increased awareness of thyroid dysfunction as a risk factor that can be mitigated, the study of the relationship of the two conditions is of much clinical and research value. Investigating the incidence, trends, and pathophysiological connections between thyroid dysfunction and MetS could be useful to recognize the high-risk groups and shape the combined healthcare approaches. The proposed study would enhance existing research by examining thyroid function impairment in patients with metabolic syndrome and its potential influence on cardiometabolic risk control.

Methodology

Study Design: This research was conducted as a hospital-based cross-sectional observational study to assess the prevalence and characteristics of thyroid dysfunction in individuals diagnosed with metabolic syndrome.

Study Area: The study was conducted in the Department of General Medicine, Nalanda Medical College and Hospital, Patna, Bihar, India.

Study Duration: The study was conducted from March 2025 to August 2025.

Study Participants

Inclusion Criteria

- Patients aged 18 years and older
- Individuals identified with metabolic syndrome according to NCEP ATP III standards
- Patients who granted written informed consent to partake in the study

Exclusion Criteria

- Patients with a prior diagnosis of thyroid problems or those undergoing thyroid medication
- Women who are pregnant and breastfeeding
- Individuals with chronic liver disease, chronic renal disease, or acute medical conditions
- Patients on drugs known to affect thyroid function (e.g., steroids, amiodarone, lithium)

Sample Size: A total of 70 patients fulfilling the inclusion criteria were enrolled in the study using a convenience sampling method.

Procedure: Detailed clinical history and demographic data were collected using a structured proforma. Anthropometric measurements, comprising height, weight, waist circumference, and body mass index (BMI), were documented. Blood pressure was assessed with established procedures. Fasting venous blood samples were obtained following an overnight fast of no less than 8–10 hours to evaluate fasting blood glucose, lipid profile, and thyroid function assays (serum T3, T4, and TSH). Metabolic syndrome was diagnosed based on NCEP ATP III criteria. Thyroid dysfunction was categorized as euthyroid, subclinical hypothyroidism, overt hypothyroidism, or hyperthyroidism according to biochemical markers.

Statistical Analysis: Data was inputted into Microsoft Excel and subsequently analyzed with SPSS

software version 27. Continuous variables were represented as mean ± standard deviation, whilst categorical variables were displayed as frequencies and percentages. The correlation between thyroid dysfunction and elements of metabolic syndrome was examined utilizing the Chi-square test and Student's t-test when applicable. A p-value of less than 0.05 was deemed statistically significant."

Result

Table 1 illustrates that the research population consisted of 70 individuals with a mean age of 52.4 ± 10.2 years, with a somewhat higher proportion of males (54.3%) compared to females (45.7%). The body mass index was 29.1 ± 3.8 kg/m², with a mean waist circumference of 98.6 ± 11.4 cm, indicating an overweight and mildly obese population. The subjects exhibited elevated systolic and diastolic blood pressure, with mean values of 136.2 ± 14.5 mmHg and 84.7 ± 9.2 mmHg, respectively. The metabolic parameters were found to have a mean of 112.5-18.3 mg/DL fasting blood glucose, high levels of triglycerides 165.4-45.7mg/dl and relatively low HDL cholesterol 41.8-8.3mg/dl indicating a population with high cardiometabolic risk.

Table 1: Demographic and Clinical Attributes of the Study Cohort (n=70)

Characteristic	Value (Mean ± SD / n, %)
Age (years)	52.4 ± 10.2
Gender	
Male	38 (54.3%)
Female	32 (45.7%)
BMI (kg/m²)	29.1 ± 3.8
Waist circumference (cm)	98.6 ± 11.4
Systolic BP (mmHg)	136.2 ± 14.5
Diastolic BP (mmHg)	84.7 ± 9.2
Fasting blood glucose (mg/dL)	112.5 ± 18.3
Triglycerides (mg/dL)	165.4 ± 45.7
HDL cholesterol (mg/dL)	41.8 ± 8.3

Table 2 shows the range of thyroid function among 70 patients with metabolic syndrome. Majority of the patients, 42 (60) were euthyroid, which implies normal thyroid functioning. The presence of hypothyroidism in 24 patients as a proportion of 34.3% of the sample was found to be the prevalent thyroid malfunction among the population. The prevalence of hyperthyroidism was not so high, with only 4 patients (5.7%). In general, the information points to the fact that although most patients with metabolic syndrome have normal thyroid functioning, a significant percentage of them have hypothyroidism, which is why thyroid screening is crucial in this population.

Table 2: Incidence of Thyroid Dysfunction in Individuals with Metabolic Syndrome (n=70)

Thyroid Status	n	%
Euthyroid	42	60.00%
Hypothyroid	24	34.30%
Hyperthyroid	4	5.70%

Table 3 illustrates that thyroid dysfunction is related to metabolic syndrome components. Hypothyroid individuals exhibited greater mean values than euthyroid and hyperthyroid values with respect to VMI (30.2 vs. 28.5 and 27.9 kg/m 2) and waist circumference (101.2 vs. 96.8 and 95.0 cm), systolic (139.8 vs. 134.5 and 132.0 mmHg) and diastolic blood pressure (86.7 vs. 83.4 and 82.5 mmHg The HDL cholesterol was marginally decreased in hypothyroid subjects (40.8mg/dl) as compared to euthyroid (42.3mg/dl) and hyperthyroid (41.0mg/dl). In general, hypothyroidism seems to have a more negative metabolic profile with hyperthyroid participants having somewhat lower or similar values to euthyroid individuals.

Table 3: Association of Thyroid Dysfunction with Metabolic Syndrome Components

Parameter	Euthyroid (n=42)	Hypothyroid (n=24)	Hyperthyroid (n=4)
BMI (kg/m²)	28.5 ± 3.6	30.2 ± 4.0	27.9 ± 2.8
Waist circumference (cm)	96.8 ± 10.5	101.2 ± 12.1	95.0 ± 8.4
Systolic BP (mmHg)	134.5 ± 13.7	139.8 ± 15.2	132.0 ± 12.1
Diastolic BP (mmHg)	83.4 ± 8.7	86.7 ± 9.8	82.5 ± 6.4
Fasting blood glucose (mg/dL)	110.8 ± 16.9	115.9 ± 20.1	111.5 ± 15.0
Triglycerides (mg/dL)	160.5 ± 42.3	173.4 ± 49.1	158.0 ± 38.7
HDL cholesterol (mg/dL)	42.3 ± 8.0	40.8 ± 8.8	41.0± 7.2

Discussion

The patient sample used was 70 patients with metabolic syndrome, with the traits of a high-risk cardiometabolic group. The average age was 52.4 years and 10.2 years, which showed that the population was of middle age, but males were slightly higher (54.3%). The mean body mass index (BMI) of 29.1248 3.8 kg/m 2 and a mean waist circumference of 98.62841114.4 cm indicates that most of the participants were overweight or slightly obese, which is in line with the diagnosis of metabolic syndrome. Higher blood pressure values (mean systolic 136.2 ± 14.5 mmHg and diastolic 84.7 ± 9.2 mmHg) also indicate the existence of cardiovascular risk factors in this group as well as metabolic abnormalities including fasting hyperglycemia (112.5 ± 18.3 mg/dL), hypertriglyceridemia (165.4 ± 45.7 mg/dL), and a low level of HDL cholesterol (4 Taken together, these results indicate the susceptibility of the population to cardiometabolic problems. According to Ford et al., (2002) [12], the presence of these clustered risk factors in middle-aged populations with metabolic syndrome was important and this proposed the importance of early screening of cardiovascular risk".

Thyroid analysis showed that most participants (60%) were euthyroid, meaning that the thyroid activity of the majority of metabolically syndrome patients was normal. Nevertheless, 34.3 percent of the cohort showed hypothyroidism, and hence it is the most common thyroid malfunction in this group. Hyperthyroidism was not very typical occurring only at 5.7 percent in participants. This distribution is congruent with the past literature indicating that hypothyroidism, specifically subclinical forms, is often related to the metabolic syndrome. The results highlight the need to check thyroid functions in patients with metabolic syndrome as hypothyroidism may be undiagnosed, which can worsen cardiometabolic risks. Esmaeilzadeh et al., (2022) [13] demonstrated that the prevalence of hypothyroidism among individuals with metabolic syndrome ranges from 20% to 40%, highlighting the interrelationship between metabolic risk and thyroid hormone imbalance.

Subsequent examination of the relationship between thyroid status and components of metabolic syndrome demonstrates that BMI, waist circumference, blood pressure, fasting glucose, and triglyceride levels were consistently elevated in hypothyroid individuals compared to those who are euthyroid and hyperthyroid. Specifically, the BMI increased to 30.2 kg/m², and the waist circumference was 101.2 cm in the hypothyroid patients. There were also increased systolic and diastolic blood pressures, 139.8 mmHg, and 86.7 mmHg, respectively. According to this trend, hypothyroidism can be one of the factors that led to the deterioration of the metabolic profile, and the possible ways include a decrease in the basal metabolic rate, lipid metabolism changes, and vascular resistance. Roos et al., (2007) [14] reported similar results pointing to the fact that hypothyroidism is associated with elevated BMI, dyslipidemia and high blood pressure increasing risks of cardiovascular conditions.

The glucose and triglyceride levels in the blood of the hypothyroid individuals (115.9 mg/dL and 173.4mg/dL respectively) also were higher than in the euthyroid (40.8 mg/dL), but the level of HDL cholesterol in the hypothyroid was lower (40.8mg/dL) than in the euthyroid. The data indicates that metabolic risk variables are concentrated among hypothyroid patients, supporting the notion that thyroid dysfunction may exacerbate insulin resistance, dyslipidemia, and hypertension in individuals with metabolic syndrome. Conversely, hyperthyroid participants exhibited metabolic parameters that were comparable to or slightly inferior to those of euthyroid individuals, suggesting that apparent hyperthyroidism may not significantly enhance the metabolic profile of this population; however, due to the limited sample size, definitive conclusions cannot be drawn. Han et al., (2018) [15] concluded that a lack of thyroid hormones slows down basal metabolic rate, consequently causing weight gain and central adiposity that are fundamental parts of metabolic syndrome.

The general result indicates that there is a close interaction between thyroid pathology, especially hypothyroidism with the level of metabolic syndrome. The increased incidence of hypothyroidism, as well as its links with the negative metabolic parameters, highlights the need of clinicians to consider thyroid screening as a component of metabolic syndrome overall management. Early detection and management of hypothyroidism could provide the chance to gain better control over metabolism, lower cardiovascular risk, and general prognosis of patients. Duntas, (2002) [16] suggested that hypothyroidism is associated with insulin resistance and dyslipidemia in the process of increasing cardiovascular risk in metabolic syndrome.

In short, the paper has revealed that even though most patients with metabolic syndrome do not have hypothyroidism, a considerable number of them show hypothyroidism, which is linked to a less favorable cardiometabolic phenotype. These observations endorse the incorporation of thyroid screening into the regular check-up of metabolic syndrome, and focus on weight, blood pressure, glucose, and lipid abnormalities in patients with hypothyroidism. The results support the general idea that even subclinical endocrine abnormalities may have far-reaching consequences for the health of metabolism.

Conclusion

According to the results of this work, it can be assumed that thyroid dysfunction, especially hypothyroidism, is common in patients with a metabolic

syndrome and is inextricably linked with a worse cardiometabolic phenotype. Although most participants were euthyroid, hypothyroidism, with increased BMI, waist circumference, blood pressure, fasting glucose, and triglyceride levels, and slightly lower HDL cholesterol levels were found in 34.3 per cent of the participants, in comparison with the euthyroid and hyperthyroid. These findings highlight the bi-directional interdependence of thyroid activity and metabolic syndrome indicating that hypothyroidism can worsen insulin resistance, dyslipidemia, and hypertension. Thus, regular monitoring of thyroid activity in individuals with metabolic syndrome is justified to make it possible to detect and treat it in time, which will reduce the cardiometabolic risk and overall clinical outcomes.

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