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Original Research Article

Prevalence of Thyroid Dysfunction in Patients with Metabolic Syndrome Attending a Tertiary Care Hospital in Bihar: A Cross-Sectional Study

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Abstract:

Background: Metabolic syndrome (MetS) is a cluster of metabolic abnormalities that raise the risk of cardiovascular disease and diabetes. It is often accompanied by thyroid dysfunction which may further worsen metabolic derangements.

Objectives: To study the incidence and pattern of thyroid dysfunction in individuals with metabolic syndrome. To study its connection with metabolic indices.

Method: This is a hospital based cross-sectional study done on 105 adult patients diagnosed with metabolic syndrome in Department of General Medicine, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar India. for a period of one year. Clinical, anthropometric and biochemical data were evaluated. Thyroid function tests (TSH, FT3, FT4) were done and patients were classified depending on thyroid status. Statistical analysis was performed using SPSS version 25.0.

Result: 29.5% of the patients had thyroid dysfunction and 70.5% were euthyroid. The most frequent anomaly was hypothyroidism, mostly subclinical rather than overt. Thyroid dysfunction was more common among the females (74.2%) and those >45 years of age. This was strongly related to central obesity, low levels of HDL, insulin resistance and hypertension.

Conclusion: Thyroid dysfunction is quite common in people with metabolic syndrome with unfavorable metabolic markers. Routine thyroid monitoring in MetS patients may help with early diagnosis and better clinical results.

Keywords: Metabolic Syndrome, Thyroid Dysfunction, Hypothyroidism, Insulin Resistance, Dyslipidemia, Central Obesity.

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Introduction

Weight gain, hypertension, an abnormal lipid profile with high triglyceride (TG) and low high-density lipoprotein (HDL) values, and elevated fasting blood sugar (FBS) levels are all included in the phrase "metabolic syndrome" [1]. Patients with metabolic syndrome are more prone to develop diabetes and cardiovascular diseases in the future. Thyroid dysfunction is common in people with metabolic syndrome [2]. Evidence of a high prevalence of the metabolic syndrome, which is spreading around the world, is seen in India.

Over the previous three decades, the incidence rose from 1.1% in 1980 to 3.85% in 2015. Between 1990 and 2015, the rate of death from high body mass index (BMI) rose by 28.3% worldwide. In India, metabolic syndrome and insulin resistance are rather prevalent. Studies have shown that the age-adjusted prevalence of metabolic syndrome in urban Indian populations is around 25% overall (31% in women and 18.5% in men) [2].

Central obesity, high TGs, poor HDL, hypertension, and hyperglycemia are all part of the metabolic syndrome, a collection of related metabolic diseases [3]. People with metabolic syndrome are more likely to die from cardiovascular disease, myocardial infarction, and stroke than people without the syndrome. Insulin resistance is believed to be the main pathophysiological cause causing the clustering [4]. Increased lipolysis produces more fatty acids as insulin activity increases, which lessens the antilipolytic effect of insulin. Leptin resistance is another possible pathophysiologic cause for the metabolic syndrome.

Free fatty acid transport to the liver generally results in increased production of apolipoprotein (APO) B, which contains TG-rich very low-density lipoprotein (LDL). Lipoprotein lipase is blocked when APO

C III levels rise, increasing TGs and the risk of atherosclerotic cardiovascular disease. A lack of insulin action causes variations in insulin production and/or clearance, which can increase or decrease to maintain euglycemia. This compensatory mechanism eventually fails due to a lack of insulin production, resulting in impaired fasting glucose and type II diabetes mellitus [5].

A number of risk factors, including hypertension, atherogenic dyslipidemia, hyperglycemia, truncal (central) obesity, and prothrombotic and proinflammatory disorders, combined to form metabolic syndrome (MetS), which raises the risk of diabetes, cardiovascular disease, and mortality. The International Diabetes Foundation estimates that around 25% of people worldwide have MetS [6].

The definition of MetS, ethnicity, age, population, and other factors all have a significant impact on the prevalence rates. Due to socioeconomic shifts toward more wealth, urbanization, automation, and urban migration, a sharp rise in its frequency has recently been seen in India [7]. MetS affects almost one-third of the urban population in major Indian cities, with an overall prevalence ranging from 11% to 56% [8].

One of the most common endocrine problems in the world is thyroid disease. An estimated 42 million Indians are thought to have thyroid disorders, according to estimates from much research [9]. Because thyroid hormones affect blood pressure, glucose, lipid metabolism, and cardiovascular dysfunction, MetS is intimately linked to thyroid dysfunction (TD) [10].

Thyroid gland dysfunction may be linked to Metabolic Syndrome (MetS) and its associated conditions, such as obesity, insulin resistance (IR), abnormalities in lipid and glucose metabolism, elevated blood pressure, and cardiovascular dysfunction. A number of similar problems, including abdominal obesity, hyperglycemia, hypertension, decreased HDL-C, and increased triglycerides (TG), are shared by both MetS and TD. Furthermore, hypothyroidism is influenced by IR, which has been found to be a fundamental mechanism for MetS [11]. Cardiovascular diseases (CVDs) may become more likely if both illnesses coexist.

In order to supplement the epidemiological data, our study evaluated the prevalence of TD in Indian patients with MetS. Investigating the clinical characteristics and related risk factors of TD in MetS patients was another goal.

Methodology

Study Design: This hospital based observational cross-sectional research was done to evaluate the prevalence and pattern of thyroid dysfunction among patients diagnosed with metabolic syndrome attending the Department of General Medicine, Netaji Subhas Medical College and Hospital. The study aimed to assess the relationship of thyroid disorders with metabolic syndrome components in adults.

Study Area: The study was done in the department of general medicine, Netaji Subhas Medical College and Hospital, Bihta, Patna, Bihar, India

Study Duration: The study was conducted over a period of one year from December 2024 to November 2025.

Sample Size: There were 105 individuals with a diagnosis of metabolic syndrome included in the research.

Study Population: Inclusion Criteria: Patients diagnosed with metabolic syndrome aged 18-65 years attending OPD or hospitalized in IPD of Department of General Medicine.

Inclusion Criteria

- Adults are 18-65 years old.
- Patients identified metabolic syndrome according to NCEP ATP III criteria.
- Department of General Medicine OPD/ IPD.
- Patients who signed written informed permission to participate in the study.

Exclusion Criteria

- Patients with known chronic systemic ailments such as chronic kidney disease, chronic liver disease, and cancer.
- Patients taking drugs altering thyroid function (eg, amiodarone, lithium, steroids).
- Pregnant or nursing ladies.
- Patients have previous thyroid surgery or radioactive iodine treatment.
- Critically sick patients and those who refused to participate in the trial.

Data Collection: Data was gathered from all the eligible patients attending the outpatient and inpatient department of the Department of General Medicine, Netaji Subhas Medical College and Hospital using a predesigned and pretested structured proforma. Detailed demographic and clinical information was gathered, including age, gender, medical history, medication history, lifestyle variables and family history of metabolic or thyroid diseases, and signed informed consent was obtained. Anthropometric data such as height, weight, body mass index (BMI), waist circumference and blood pressure were taken using established protocols. After overnight fasting, fasting venous blood samples were taken with aseptic measures for measurement of fasting blood glucose, lipid profile and thyroid function tests including thyroid stimulating hormone (TSH), free triiodothyronine (FT3) and free thyroxine (FT4). All laboratory studies were performed at the central labora-

tory of the institution by using normal laboratory techniques.

Study Procedure: During the trial period, patients diagnosed with metabolic syndrome according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria were evaluated for eligibility. Eligible individuals who met inclusion criteria were enrolled sequentially after describing the aim and objectives of the study and receiving written informed permission. Detailed clinical examination of each subject was undertaken and anthropometric and biochemical characteristics were recorded. Blood pressure was taken in sitting posture after enough rest. Waist circumference was measured using non stretchy measuring tape. Biochemical analysis and estimation of thyroid profile was done using fasting blood samples. Patients were classified as euthyroid, overt hypothyroid, subclinical hypothyroid, overt hyperthyroid and subclinical hyperthyroid according to thyroid hormone levels. The data obtained was methodically arranged and analyzed to assess the prevalence of thyroid dysfunction and its connection with different components of metabolic syndrome.

HOMA-IR will be calculated:

$$HOMA\text{-}IR = \frac{Fasting\ Insulin \times Fasting\ Glucose}{405}$$

Statistical Analysis: The acquired data were input in Microsoft Excel and analyzed by Statistical Package for Social Sciences (SPSS) software version 25.0. Continuous data were reported as mean ± SD, and categorical variables were expressed as frequency and percentage.

Chi-square test or Fisher's exact test whenever appropriate was used to assess the relationship of thyroid dysfunction with components of metabolic syndrome. Quantitative factors were compared between groups by independent t-test. Statistical significance was defined as a p-value < 0.05.

Result

Table 1 presents the demographic and baseline characteristics of the research participants. In the current study, total number of 105 individuals with metabolic syndrome were included. Among them, 43 participants were in age group of ≤45 years and 62 individuals were >45 years of age. The mean age of study population was 48.5 ± 10.4 years. The study population was predominantly female (59.0% vs. 41.0% male). The mean body mass index (BMI) of the participants was 29.9 ± 3.9 kg/m2, implying that most of the patients were overweight or obese. The mean waist circumference was 98.4 ± 8.9 cm, indicating a significant incidence of central obesity among the research subjects.

Table 1: Demographic and Baseline Characteristics of Study Participants (N = 105)

Parameters	Age ≤ 45 Years (n = 43)	Age > 45 Years (n = 62)	Total (N = 105)
Mean Age (Years)	37.4 ± 5.9	56.2 ± 6.1	48.5 ± 10.4
Age Range (Years)	22–45	46–68	22–68
Female, n (%)	24 (55.8%)	38 (61.3%)	62 (59.0%)
Male, n (%)	19 (44.2%)	24 (38.7%)	43 (41.0%)
Height (cm), Mean ± SD	162.8 ± 8.5	160.9 ± 7.9	161.7 ± 8.2
Weight (kg), Mean ± SD	78.6 ± 11.4	76.1 ± 12.2	77.1 ± 11.8
BMI (kg/m²), Mean ± SD	29.2 ± 3.6	30.4 ± 4.2	29.9 ± 3.9
Waist Circumference (cm), Mean ± SD	97.4 ± 8.7	99.1 ± 9.2	98.4 ± 8.9
Hip Circumference (cm), Mean ± SD	104.8 ± 10.3	106.2 ± 10.7	105.6 ± 10.5

Table 2 indicates the frequency and distribution of thyroid impairment in patients with metabolic syndrome. Among 105 patients with metabolic syndrome, 31 patients (29.5%) were identified as thyroid dysfunction, and 74 patients (70.5%) were euthyroid. The most prevalent abnormality among hypothyroidism sufferers was thyroid malfunction. Among patients, 15.2% had known hypothyroidism and new diagnoses of subclinical hypothyroidism and overt hypothyroidism were identified in 8.6% and 2.9%, respectively. Hyperthyroidism was considerably less frequent. The bulk of the instances of thyroid dysfunction were in female patients (74.2%) and male patients only 25.8%. In addition, thyroid dysfunction was more common in persons aged >45 years (61.3%) than in younger ones.

Table 2: Prevalence and Distribution of Thyroid Dysfunction among Patients with Metabolic Syndrome (N = 105)		
Variables	**Number (n)**	**Percentage (%)**
Classification of Thyroid Dysfunction		
Known Hypothyroidism	16	15.2
Newly Diagnosed Overt Hypothyroidism	3	2.9
Newly Diagnosed Subclinical Hypothyroidism	9	8.6
Known Hyperthyroidism	2	1.9
Newly Diagnosed Subclinical Hyperthyroidism	1	1
Newly Diagnosed Overt Hyperthyroidism	0	0
Total Thyroid Dysfunction Cases	**31**	**29.5**
Euthyroid Cases	74	70.5
Gender-wise Distribution of TD Cases (n = 31)		
Female	23	74.2
Male	8	25.8
Age-wise Distribution of TD Cases (n = 31)		
≤ 45 Years	12	38.7
> 45 Years	19	61.3

Table 3 demonstrates the distribution of components of metabolic syndrome in individuals with thyroid impairment. In the 31 individuals with thyroid dysfunction, the most prevalent component of metabolic syndrome was waist circumference increase (96.8% of patients). Reduced HDL cholesterol was detected in 87.1% of patients and elevated HOMA-IR values were found in 83.9% of cases. The prevalence of high systolic blood pressure, elevated diastolic blood pressure and raised fasting blood glucose was 77.4%, 58.1% and 54.8% correspondingly. Triglycerides were elevated to 35.5% of the individuals. The results suggest that thyroid dysfunction is strongly related to the components of metabolic syndrome, specifically central obesity, insulin resistance and dyslipidemia.

Table 3: Distribution of Metabolic Syndrome Components among Patients with Thyroid Dysfunction (N = 31)		
Metabolic Syndrome Components	**Number (n)**	**Percentage (%)**
Increased Waist Circumference	30	96.8
Reduced HDL Cholesterol	27	87.1
Raised HOMA-IR	26	83.9
Elevated Systolic Blood Pressure	24	77.4
Elevated Diastolic Blood Pressure	18	58.1
Elevated Fasting Blood Glucose	17	54.8
Elevated Triglycerides	11	35.5

Table 4 presents the clinical, biochemical and thyroid profile among the study participants. The mean serum TSH level was 4.96 ± 2.84 μIU/mL. The mean FT3 and FT4 values were 2.84 ± 0.76 pg/mL and 1.16 ± 0.34 ng/dL, respectively. The lipid profile showed increased mean total cholesterol and triglyceride levels of 206.5 ± 34.8 mg/dL and 176.2 ± 42.6 mg/dL respectively. Mean HDL cholesterol was relatively low (39.4 ± 7.2 mg/dL) while LDL cholesterol was high (126.8 ± 28.5 mg/dL). The mean systolic blood pressure and diastolic blood pressure were 136.4 ± 14.2 mmHg and 88.6 ± 9.7 mmHg respectively. The average fasting blood glucose level was 122.5 ± 28.4 mg/dL and the average HOMA-IR score was 2.14 ± 0.82, suggesting that a considerable number of individuals had insulin resistance. These data indicate that thyroid dysfunction in metabolic syndrome is accompanied by unfavorable biochemical and metabolic disturbances.

Table 4: Clinical, Biochemical, and Thyroid Profile among Study Participants (N = 105)	
Parameters	**Mean ± SD**
Thyroid Profile	
TSH (μIU/mL)	4.96 ± 2.84
FT3 (pg/mL)	2.84 ± 0.76
FT4 (ng/dL)	1.16 ± 0.34
Lipid Profile	
Total Cholesterol (mg/dL)	206.5 ± 34.8
Triglycerides (mg/dL)	176.2 ± 42.6
HDL Cholesterol (mg/dL)	39.4 ± 7.2
LDL Cholesterol (mg/dL)	126.8 ± 28.5
Blood Pressure and Glycemic Parameters	
Systolic Blood Pressure (mmHg)	136.4 ± 14.2
Diastolic Blood Pressure (mmHg)	88.6 ± 9.7
Fasting Blood Glucose (mg/dL)	122.5 ± 28.4
HOMA-IR	2.14 ± 0.82

BMI categorization of research participants is presented in Table 5. Most of the research participants were overweight or obese based on BMI categorization. Class I obesity was the most common class (43.8% of the patients), followed by class II obesity (26.7% of the participants). The research population comprised 18.1% overweight people with just 11.4% of normal body weight. These data suggest obesity is common in individuals with metabolic syndrome and may have a role in the pathogenesis of thyroid dysfunction and related metabolic abnormalities.

Table 5: BMI Classification among Study Participants (N = 105)		
BMI Category	**Number (n)**	**Percentage (%)**
Normal Weight (<23 kg/m²)	12	11.40%
Overweight (23–24.9 kg/m²)	19	18.10%
Class I Obesity (25–29.9 kg/m²)	46	43.80%
Class II Obesity (≥30 kg/m²)	28	26.70%

Table 6 illustrates the connection between gender and thyroid disorders. The relationship between gender and thyroid dysfunction found that thyroid dysfunction was much more prevalent in females than males. Among the 62 females, 23 individuals were suffering from thyroid dysfunction, whereas among 43 males, only 8 were identified with thyroid abnormalities. These results reveal a female preponderance of thyroid impairment in patients with metabolic syndrome. Hormonal differences, immunological propensity and metabolic variables may make females more vulnerable.

Table 6: Association between Thyroid Dysfunction and Gender (N = 105)			
Gender	**Thyroid Dysfunction Present**	**Thyroid Dysfunction Absent**	**Total**
Female	23	39	62
Male	8	35	43
Total	**31**	**74**	**105**

Discussion

The present cross-sectional study was done to assess the prevalence of thyroid dysfunction among patients with metabolic syndrome visiting a tertiary care hospital in Bihar. In the present research thyroid dysfunction was seen in 29.5% of the individuals with metabolic syndrome and 70.5% were euthyroid. The data suggest a high prevalence of thyroid dysfunction in subjects with metabolic syndrome, and it could be an important contributor to the worsening of metabolic abnormalities and cardiovascular risk. Gupta *et al.* also reported similar finding as they discovered prevalence of thyroid dysfunction of 28.5% among metabolic syndrome patients at a tertiary care facility in India which is very near to prevalence seen in the present research [12]. Another research by Senthil *et al.* similarly showed significant incidence of thyroid abnormalities in individuals with metabolic syndrome underlining the tight association of thyroid dysfunction with metabolic derangements" [13].

In the present investigation, the most prevalent thyroid condition observed was hypothyroidism. Known hypothyroidism was found in 15.2% of patients, whereas subclinical and overt hypothyroidism were reported in 8.6% and 2.9%, respectively.

Hyperthyroidism was rare. These data are in agreement with Gupta *et al.* [12], who showed that the prevalence of subclinical hypothyroidism and overt hypothyroidism was 18.5% and 8.5%, respectively. Similarly, Harish *et al.* found subclinical hypothyroidism in 21% and overt hypothyroidism in 9% of individuals with metabolic syndrome [14]. The high rates of hypothyroidism seen in these studies support the concept that lower thyroid hormone activity may have a negative effect on lipid metabolism, insulin sensitivity and body weight control, raising the risk of metabolic syndrome.

In the current study, gender preponderance was obviously noticed with females representing 74.2% of thyroid dysfunction patients. Similar findings related to gender with a much higher prevalence of thyroid disorders in women than males have been reported in earlier research from India. Higher incidence in females may be associated with hormonal factors, autoimmune vulnerability and greater risk of thyroid diseases in women. In their study in Bihar, Sinha *et al.* similarly reported a larger percentage of female individuals with thyroid dysfunction and metabolic syndrome. The present study also showed that thyroid dysfunction was more prevalent among the individuals aged more than 45 years which indicates that higher age can be one of the causes of endocrine and metabolic problems.

In the present investigation, central obesity was the most frequent component of metabolic syndrome associated with thyroid dysfunction, seen in 96.8% of thyroid dysfunction patients. Low HDL cholesterol levels and high HOMA-IR scores were also quite common. Ray *et al.* found a substantial relationship between thyroid dysfunction and obesity, dyslipidemia, hypertension and insulin resistance in metabolic syndrome. Thyroid hormones are involved in basal metabolic rate and lipid utilization; reduced activity of thyroid hormones can contribute to increased adiposity, poor glucose metabolism and aberrant fat buildup.

Here, the mean BMI of the participants was 29.9 ± 3.9 kg/m², and most of the patients were overweight or obese. Class I obesity was the greatest BMI group. Obesity has been shown to be one of the main pathogenic factors in metabolic syndrome and may have a role in thyroid malfunctioning via inflammatory cytokines and leptin-mediated processes. Similar results have been observed in investigations in Indian communities where obesity and increased waist circumference were substantially related with high TSH levels and thyroid dysfunction [15].

The lipid profile findings of the present investigation showed increased levels of total cholesterol, triglycerides and LDL cholesterol and decreased levels of HDL cholesterol. These anomalies reflect a higher cardiovascular risk in people with concurrent thyroid disease and metabolic syndrome. Thyroid hormone insufficiency is known to disrupt lipoprotein processing and decrease LDL receptor activation, leading to increased circulating lipid levels. Bhaleghare *et al*. also showed substantial impairment of lipid measures in metabolic syndrome individuals with thyroid disease. Similar biochemical abnormality was also seen in the study done by Sridevi *et al,* where metabolic syndrome patients with thyroid dysfunction had greater triglyceride levels and insulin resistance compared to euthyroid persons [16].

In the present investigation, we found that individuals with thyroid dysfunction had higher fasting blood glucose and HOMA-IR, indicating considerable insulin resistance. Thyroid hormones affect glucose metabolism by modulating hepatic glucose output, insulin secretion and peripheral glucose consumption. Thyroid hormone deficiency can consequently increase insulin resistance and glycemic state. Similar findings were seen in numerous prior investigations of the association between thyroid dysfunction and metabolic syndrome [16].

The combination of thyroid dysfunction and metabolic syndrome in the present study emphasizes the necessity of frequent monitoring of thyroid function in patients with metabolic syndrome, particularly in females, obese and elderly. Early diagnosis and treatment of thyroid dysfunction may improve metabolic parameters, minimize cardiovascular risk and avoid long-term consequences. The present investigation, however, was hampered by being a single-center study with a rather small sample size. Future bigger and multicentric investigations are needed to better establish the causal link between thyroid dysfunction and metabolic syndrome.

Conclusion

The current study demonstrates a significant incidence of thyroid dysfunction in individuals with metabolic syndrome. Almost one-third of the study group had thyroid dysfunction. Hypothyroidism is the most frequent anomaly, especially subclinical hypothyroidism. Thyroid dysfunction was more common in females and in those over 45 years of age and was significantly associated with major components of metabolic syndrome such as central obesity, dyslipidemia, insulin resistance and hypertension. These findings emphasize the important connection between thyroid function and metabolic derangements which may synergistically act to enhance the risk of cardiovascular problems. Hence, regular screening for thyroid abnormalities in individuals with metabolic syndrome is crucial, particularly in high-risk populations, for early identification and prompt management. Early therapy of thyroid dysfunction may improve metabolic outcomes, and minimize long term morbidity, however bigger multicentric studies are necessary to fully explain the causal link and underlying processes.

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