



ASSESSMENT OF THYROID PROFILE IN PATIENTS WITH METABOLIC SYNDROME

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ABSTRACT

Background: Metabolic syndrome (MetS) is a cluster of metabolic abnormalities including central obesity, insulin resistance, dyslipidemia, and hypertension, which significantly increase the risk of cardiovascular disease and type 2 diabetes mellitus. Thyroid hormones play a crucial role in regulating metabolism, and their dysfunction has been increasingly associated with components of MetS.

Objective: The present study aimed to evaluate thyroid function in patients with metabolic syndrome and to determine the association between thyroid hormone abnormalities and various metabolic parameters.

Methods: This cross-sectional study was carried out in the various departments of the National Institute of Medical Sciences Research & Hospital, Jaipur, Rajasthan, where patients diagnosed with metabolic syndrome were evaluated for thyroid function. The study was conducted over 18 months. A total of 134 patients aged ≥ 18 years with metabolic syndrome were enrolled after applying predefined inclusion and exclusion criteria and obtaining written informed consent. Sociodemographic and clinical data were collected using a semi-structured proforma. Thyroid profile was assessed by measuring serum thyroid-stimulating hormone (TSH), triiodothyronine (T3), and thyroxine (T4). Data thus analysed categorically and continuous variables were represented as frequencies and percentages.

Results: The mean age of the participants was 50.50 ± 8.91 years with 66 (49.3%) were male and 68 (50.7%) were female. The mean systolic and diastolic blood pressures were 143.0 ± 6.42 mmHg and 88.72 ± 3.87 mmHg, respectively. The mean serum TSH, T3, and T4 levels were 7.25 ± 2.90 μ IU/mL, 0.79 ± 0.23 ng/mL, and 5.04 ± 1.02 μ g/dL, respectively. Overall, thyroid dysfunction was observed in 92 of 134 participants (68.4%), whereas 42 (31.6%) were euthyroid. Overt hypothyroidism was observed in 41 participants (30.7%), hypothyroidism in 29 (21.9%), and subclinical hypothyroidism in 21 (15.8%).

Conclusion: Thyroid dysfunction, predominantly hypothyroid states, was frequently observed among patients with metabolic syndrome in this study. The high occurrence of thyroid abnormalities emphasizes the importance of routine thyroid function assessment in patients with metabolic syndrome. Early identification and correction of thyroid abnormalities may improve metabolic control, reduce complications, and contribute to better long-term outcomes.

KEYWORDS: Metabolic Syndrome, Thyroid Dysfunction, Hypothyroidism, Thyroid Stimulating Hormone, Subclinical hypothyroidism.

Introduction

Metabolic syndrome (MetS) represents a constellation of interrelated risk factors including central obesity, insulin resistance, dyslipidemia, hypertension that significantly elevate the likelihood of developing cardiovascular disease (CVD), type 2 diabetes mellitus (T2DM), and all-cause mortality. The syndrome has emerged as a global epidemic, affecting nearly one-quarter of the adult population worldwide and exhibiting rising prevalence even in younger age groups due to sedentary lifestyles, increasing obesity rates, and poor dietary habits[1]. The International Diabetes Federation (IDF) and National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) reported the prevalence rates ranging from 20% to 40% in adult populations, with higher frequencies observed in urbanized regions and among postmenopausal women. In India, the reported prevalence of MetS is rising rapidly, with estimates suggesting rates between 25% and 45% depending on regional and socioeconomic factors[2].

The pathophysiology of MetS is multifactorial and involves a complex interaction between genetic susceptibility, environmental factors, insulin resistance, chronic low-grade inflammation, oxidative stress, and alterations in adipokine signalling. Insulin resistance is considered a major underlying mechanism, contributing to hyperglycaemia, dyslipidaemia, and endothelial dysfunction. Excess adiposity, particularly visceral obesity, further promotes the release of inflammatory mediators and contributes to metabolic and vascular abnormalities. The clustering of these risk factors ultimately predisposes affected individuals to atherosclerotic cardiovascular disease and T2DM[3-6].

Thyroid hormones play vital role in maintaining metabolic homeostasis. Triiodothyronine (T3) and thyroxine (T4), under the regulatory control of thyroid-stimulating hormone (TSH), influence basal metabolic rate, thermogenesis, lipid metabolism, carbohydrate metabolism, energy expenditure, and body weight. Consequently, disturbances in thyroid function can have important metabolic consequences. Hypothyroidism, both overt and subclinical, has been associated with reduced energy expenditure, weight gain, dyslipidaemia, and insulin resistance, whereas hyperthyroidism may result in increased metabolic activity and abnormalities in glucose metabolism. Even subtle variations in thyroid hormone levels within the reference range may influence metabolic homeostasis and cardiovascular risk[3,7].

The relationship between thyroid dysfunction and MetS may also be bidirectional. Thyroid dysfunction can potentially aggravate metabolic abnormalities through its effects on lipid and glucose metabolism, body weight, and energy expenditure. Metabolic disturbances associated with obesity and insulin resistance may influence thyroid physiology by affecting peripheral thyroid hormone metabolism, deiodinase activity, and TSH regulation. The overlapping

pathophysiological mechanisms make the assessment of thyroid status particularly relevant in patients diagnosed with MetS[7,8]. In view of the close association between thyroid hormones and metabolic regulation, the present study was aimed to assess the thyroid profile among patients diagnosed with metabolic syndrome and determine the occurrence and pattern of thyroid dysfunction in this population. The study also aimed to evaluate serum TSH, T3, and T4 levels and classified participants according to their thyroid function status.

Materials and Methods

Study Design and Settings

This was a hospital-based, cross-sectional study conducted at the National Institute of Medical Sciences Research & Hospital, NIMS University Rajasthan, Jaipur. Patients diagnosed with metabolic syndrome attending various departments of the hospital were evaluated for their thyroid profile. The study was conducted over a period of 18 months. The study was performed in accordance with the principles of Declaration of Helsinki and the Institutional Ethics Committee approval was obtained (Ref. No.: NIMSUR/IEC/2024/1083, dated 22/05/2024).

Study Participants

Study participants were assessed based on the pre-defined following inclusion and exclusion criteria.

Inclusion Criteria:

- The age of the patient was 18 years or above, of any sex.
- All patients diagnosed with metabolic syndrome were included.
- Patients who provided informed consent to participate in the study were included.

Exclusion Criteria:

- Patients on weight loss therapies and known HIV-positive cases were excluded.
- Patients with any form of chronic liver disease or hepatocellular carcinoma were excluded.
- Individuals below 18 years of age were excluded.
- Pregnant women were excluded.

Sample Size Calculation

The sample size was calculated using the standard formula for prevalence studies:

$$n = \frac{Z_{1-\alpha/2}^2 \times p \times (1 - p)}{d^2}$$

Where,

- Z = Inverse probability of normal distance at 95% confidence interval = 1.96
- P = Prevalence rate of metabolic syndrome = 0.335
- d = Margin of error (8%)

Therefore,

$$\frac{1.96^2 \times 0.335 \times (1 - 0.335)}{0.08^2} \approx 133.7 \sim 134$$

The calculated sample size was 134 patients.

Study Procedure

After taking approval from the Scientific and Ethics Committee of NIMS University Rajasthan, Jaipur, eligible participants were enrolled after obtaining written informed consent. Sociodemographic and clinical information was collected using a semi-structured proforma specifically designed for the study. The diagnosis of metabolic syndrome was established according to the standard clinical and biochemical criteria used in the study. Blood samples were collected from enrolled participants for assessment of thyroid function. Thyroid profile parameters included thyroid-stimulating hormone (TSH), free triiodothyronine (FT3), and free thyroxine (FT4). Laboratory investigations were performed according to standard laboratory protocols. Based on the thyroid profile results, participants were categorized according to their thyroid function status. The study assessed the occurrence and pattern of thyroid dysfunction among patients with metabolic syndrome.

Outcome Measurements

The primary outcome of the study was the thyroid profile of patients with metabolic syndrome, assessed using serum TSH, T3, and T4 measurements. The occurrence and distribution of thyroid dysfunction, including hypothyroid states and subclinical hypothyroidism, were also evaluated.

Statistical Analysis

All the necessary data were collected, entered into Microsoft Excel and analyzed using IBM SPSS version 25.0. Data thus analyzed categorically. Continuous variables summarized by mean $\pm$ SD and categorical data represented as frequencies and percentages.

Results

Demographic Details

The mean age of the study participants was 50.50 ± 8.91 years. Of the 134 participants, 66 (49.3%) were males and 68 (50.7%) were females. With respect to residential status, 73 (54.4%) participants were from urban areas, whereas 61 (45.6%) were from rural areas (Table 1).

Table 1: Demographic Characteristics of the Study Participants

Characteristics		No. of Participants [N = 134]
Age, years (mean $\pm$ SD)		50.50 $\pm$ 8.91
Sex, n (%)	Male	66 (49.3)
	Female	68 (50.7)
Area of Residence, n (%)	Rural	61 (45.6)
	Urban	73 (54.4)

Clinical Parameters

The mean systolic blood pressure among the study participants was 143.0 ± 6.42 mmHg, while the mean diastolic blood pressure was 88.72 ± 3.87 mmHg. The mean pulse rate was 82.09 ± 4.09 beats/min. The mean oxygen saturation was $96.8 \pm 1.9\%$, and the mean respiratory rate was 18.6 ± 2.1 breaths/min (Table 2).

Table 2: Clinical Characteristics of the Study Participants

Parameters	Value (Mean $\pm$ SD)
Systolic blood pressure (mmHg)	143.0 $\pm$ 6.42
Diastolic blood pressure (mmHg)	88.72 $\pm$ 3.87
Pulse rate (beats/min)	82.09 $\pm$ 4.09
Oxygen saturation (%)	96.8 $\pm$ 1.9
Respiratory rate (breaths/min)	18.6 $\pm$ 2.1

Thyroid Profile

The mean serum TSH level was 7.25 ± 2.90 μ IU/mL. The mean T3 level was 0.79 ± 0.23 ng/mL, whereas the mean T4 level was 5.04 ± 1.02 μ g/dL. Table 3 summarizes the thyroid profile of the participants.

Table 3: Thyroid Profile of the Study Participants

Parameters	Value (Mean $\pm$ SD)
TSH (μ IU/mL)	7.25 $\pm$ 2.90
T3 (ng/mL)	0.79 $\pm$ 0.23
T4 (μ g/dL)	5.04 $\pm$ 1.02

Thyroid Function Status

Among the 134 participants, 42 (31.6%) were euthyroid, while 92 (68.4%) had thyroid dysfunction. Overt hypothyroidism was reported in 41 participants (30.7%), hypothyroidism in 29 (21.9%), and subclinical hypothyroidism in 21 (15.8%), Figure 1.

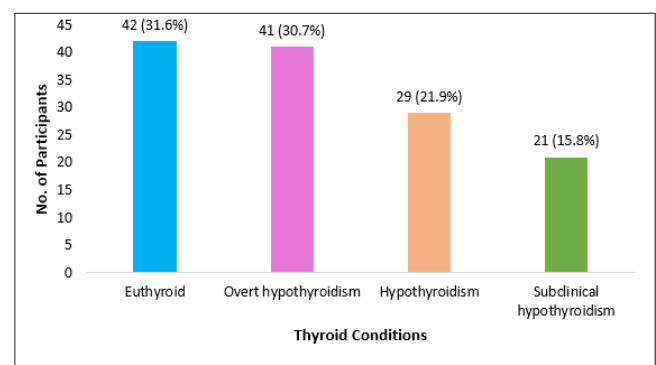


Figure 1. Distribution of Thyroid Function Status among Study Participants

Discussion

The present cross-sectional study assessed the thyroid

profile and pattern of thyroid dysfunction among the patients with metabolic syndrome. The findings demonstrated a considerable burden of thyroid abnormalities in this population. The mean age of the participants was 50.50 ± 8.91 years, with an almost equal distribution of males [66 (49.3%)] and females [68 (50.7%)]. Overall, thyroid dysfunction was reported in 92 (68.4%) participants, whereas 42 (31.6%) had normal thyroid function. These findings suggest that abnormalities in thyroid function were frequently observed among the patients with metabolic syndrome included in the present study.

A similar observation was reported by Sharma et al. (2021), who found no significant gender difference in metabolic syndrome prevalence[9]. However, in contrast, Ford et al. (2002) reported a higher prevalence among females, suggesting that hormonal factors and postmenopausal status may influence susceptibility[10]. The higher proportion of urban participants (54.4%) reflects the increasing burden of metabolic syndrome in urban populations, likely due to lifestyle transitions, consistent with Gupta et al. (2012), who highlighted higher urban prevalence linked to dietary patterns and reduced physical activity[11], whereas Misra et al. (2001) emphasized the rising trend even in rural populations due to epidemiological transition[12].

The clinical parameters of the participants demonstrated elevated mean systolic (143.0 ± 6.42 mmHg) and diastolic blood pressure (88.72 ± 3.87 mmHg), which are hallmark features of metabolic syndrome. These findings underscore the clustering of cardiovascular risk factors in this population. Similar findings were reported by Alberti et al. (2009), who described hypertension as a primary component of metabolic syndrome[13].

The thyroid profile analysis demonstrated elevated mean TSH levels (7.25 ± 2.90 μ IU/mL) along with relatively reduced T3 and T4 levels, indicating a trend toward hypothyroidism among patients with metabolic syndrome. This suggests a possible pathophysiological link between thyroid dysfunction and metabolic disturbances such as dyslipidemia and insulin resistance. Chakrabarti et al. (2011) reported similar findings, showing elevated TSH levels in metabolic syndrome patients[14]. On the other hand, Roos et al. (2007) suggested that variations in thyroid hormone levels within the normal range may also influence metabolic parameters, indicating that even subtle thyroid changes can have clinical significance[15].

The distribution of thyroid function status further reinforces this association, with only 31.6% of participants being euthyroid, while the majority exhibited some form of thyroid dysfunction. Overt hypothyroidism (30.7%) and hypothyroidism (21.9%) constituted a significant proportion, followed by subclinical hypothyroidism (15.8%). These findings highlight the predominance of hypothyroid states in patients with metabolic syndrome. Meher et al. (2013) also reported a high prevalence of hypothyroidism in such

patients[16]. In contrast, Canaris et al. (2000) found lower prevalence rates in the general population, suggesting that metabolic syndrome may significantly increase the risk of thyroid dysfunction[17].

The overall occurrence of thyroid dysfunction was notably high, affecting 68.4% of the study population. This indicates that more than two-thirds of individuals with metabolic syndrome had altered thyroid function. This finding aligns with Uzunlulu et al. (2007), who demonstrated a high prevalence of thyroid dysfunction in metabolic syndrome patients[18].

However, the study has also certain limitations. The cross-sectional design limits establishing a temporal or causal relationship between thyroid dysfunction and metabolic syndrome. The study was conducted at a single centre with a relatively small sample size, which may limit the generalizability of the findings. Additional thyroid parameters including anti-thyroid antibodies (anti-TPO, anti-Tg) could have provided more comprehensive thyroid evaluation. Furthermore, detailed statistical analyses assessing the association between thyroid dysfunction and individual components of metabolic syndrome were not available. Therefore, larger multicentre prospective studies are warranted to better elucidate the relationship between thyroid abnormalities and metabolic syndrome.

Conclusion

This study demonstrated that thyroid dysfunction was frequently observed among patients with metabolic syndrome, with hypothyroid states being the predominant abnormality. The findings also demonstrated that more than two-third of the study population had some form of thyroid dysfunction, indicating a substantial burden of endocrine abnormalities in these patients. The results suggested that routine screening for thyroid dysfunction should be incorporated into the clinical evaluation of patients with metabolic syndrome to enable early diagnosis and timely management. Addressing thyroid abnormalities may not only improve metabolic parameters but also potentially reduce disease severity and improve overall prognosis. Further large-scale and longitudinal studies are recommended to better understand the underlying mechanisms and to establish causal relationships between thyroid dysfunction and metabolic syndrome.

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Conflict of Interest

The authors do not have any conflicts of interest.

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