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Original Research Article

PREVALENCE OF HYPOTHYROIDISM IN PATIENTS WITH METABOLIC SYNDROME

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ABSTRACT

Background: Metabolic syndrome represents a cluster of metabolic abnormalities including central obesity, dyslipidemia, hypertension, and impaired glucose metabolism, which significantly increase the risk of cardiovascular disease and diabetes. Thyroid hormones play a crucial role in metabolic regulation, and thyroid dysfunction has been increasingly recognized as an important contributor to metabolic disturbances. **Objective:** To determine the prevalence of hypothyroidism in patients with metabolic syndrome and to evaluate its association with metabolic abnormalities.
Materials and Methods: A hospital-based cross-sectional study was conducted among 300 patients diagnosed with metabolic syndrome according to NCEP ATP III criteria. Demographic characteristics, lifestyle factors, anthropometric measurements, laboratory parameters, and thyroid function tests including TSH, FT3, and FT4 were recorded and analyzed.
Results: The mean age of the participants was 47.22 ± 13.18 years. Males and females were equally represented in the study population. Hypothyroidism was observed in 216 participants (72.0%), while 84 participants (28.0%) were euthyroid. Among hypothyroid patients, 85 (39.4%) had subclinical hypothyroidism and 131 (60.6%) had overt hypothyroidism. Laboratory findings showed elevated fasting glucose levels (128.71 ± 29.03 mg/dL) and significant dyslipidemia with mean triglyceride levels of 201.26 ± 46.00 mg/dL and mean total cholesterol levels of 215.26 ± 39.09 mg/dL.
Conclusion: The study demonstrates a high prevalence of hypothyroidism among patients with metabolic syndrome, suggesting a strong association between thyroid dysfunction and metabolic abnormalities. Routine thyroid function screening may be beneficial in patients with metabolic syndrome to facilitate early diagnosis and improve metabolic and cardiovascular outcomes.
Keywords: Hypothyroidism, Metabolic syndrome, Thyroid function, Dyslipidemia.

INTRODUCTION

Metabolic syndrome (MetS) is a cluster of metabolic abnormalities characterized by central obesity, insulin resistance, dyslipidemia, hypertension, and impaired glucose metabolism. These factors collectively increase the risk of cardiovascular diseases and type 2 diabetes mellitus, making metabolic syndrome an important public health concern worldwide. Rapid urbanization, sedentary lifestyle, unhealthy dietary habits, and increasing prevalence of obesity have contributed significantly to the rising incidence of metabolic syndrome across both developed and developing countries. Studies have estimated that approximately one-fourth of the global adult population may be affected by metabolic syndrome, emphasizing its growing clinical significance and the need for early identification of associated risk factors.[1]

Thyroid hormones play a critical role in the regulation of metabolic homeostasis. They influence multiple physiological processes including lipid metabolism, carbohydrate metabolism, energy expenditure, and thermogenesis. Any disturbance in thyroid hormone levels can lead to significant metabolic alterations. Hypothyroidism, a common endocrine disorder characterized by insufficient thyroid hormone production, has been associated with several metabolic abnormalities such as weight gain, dyslipidemia, impaired glucose metabolism, and reduced basal metabolic rate. These metabolic disturbances closely resemble the components of metabolic syndrome, suggesting a possible association between thyroid dysfunction and metabolic syndrome.[2]

Hypothyroidism can present as either overt hypothyroidism or subclinical hypothyroidism. Subclinical hypothyroidism is defined by elevated thyroid-stimulating hormone (TSH) levels with normal circulating thyroid hormone concentrations and is often asymptomatic. Despite the absence of obvious clinical manifestations, subclinical hypothyroidism has been associated with metabolic disturbances including increased body mass index, lipid abnormalities, insulin resistance, and endothelial dysfunction. These metabolic changes may contribute to the development and progression of metabolic syndrome as well as increase the risk of cardiovascular morbidity.[3]

Several studies have demonstrated that thyroid dysfunction is more prevalent among individuals with metabolic syndrome compared to the general population. Hypothyroidism is known to alter lipid metabolism, leading to elevated levels of total cholesterol, low-density lipoprotein cholesterol, and triglycerides. These lipid abnormalities play an important role in the pathogenesis of atherosclerosis and cardiovascular diseases. Additionally, reduced thyroid hormone levels can impair glucose metabolism and decrease insulin sensitivity, further contributing to the metabolic disturbances observed in metabolic syndrome.[4]

The relationship between hypothyroidism and metabolic syndrome appears to be complex and multifactorial. Thyroid hormones influence adipocyte differentiation, lipid storage, and energy balance. In hypothyroidism, decreased metabolic rate and impaired lipid mobilization lead to increased adiposity, particularly central obesity, which is a key component of metabolic syndrome. Furthermore, thyroid hormone deficiency may contribute to systemic inflammation, oxidative stress, and endothelial dysfunction, thereby aggravating metabolic and cardiovascular risks.[5]

Recent epidemiological studies have suggested a strong association between subclinical hypothyroidism and metabolic syndrome. Individuals with subclinical hypothyroidism have been found to exhibit higher prevalence of metabolic syndrome components including abdominal obesity, hypertension, hypertriglyceridemia, and low high-density lipoprotein cholesterol levels. These findings indicate that even mild thyroid dysfunction may significantly influence metabolic health and contribute to cardiometabolic risk.[6]

Another important aspect of the relationship between thyroid dysfunction and metabolic syndrome is the potential bidirectional interaction between the two conditions. Metabolic syndrome itself may influence thyroid function through mechanisms such as chronic inflammation, insulin resistance, and alterations in adipokine levels. These metabolic disturbances can affect hypothalamic-pituitary-thyroid axis regulation and may contribute to the development of thyroid dysfunction.[7]

From a clinical perspective, the coexistence of hypothyroidism and metabolic syndrome may further increase the risk of cardiovascular complications. Patients with both conditions may exhibit more severe lipid abnormalities, endothelial dysfunction, and increased atherogenic risk. Therefore, identification of thyroid dysfunction in individuals with metabolic syndrome is essential for early intervention and appropriate management to reduce long-term complications.[8]

Despite increasing evidence supporting the association between thyroid dysfunction and metabolic syndrome, the reported prevalence of hypothyroidism among patients with metabolic syndrome varies widely across different populations. Differences in demographic characteristics, iodine intake, genetic susceptibility, and lifestyle factors may influence the occurrence of thyroid dysfunction in these individuals. Therefore, region-specific studies are necessary to better understand the prevalence and clinical significance of hypothyroidism among patients with metabolic syndrome.[9]

Considering the growing burden of metabolic syndrome and the potential metabolic impact of thyroid dysfunction, evaluation of thyroid status in patients with metabolic syndrome has important diagnostic and therapeutic implications. Early detection of hypothyroidism may facilitate timely management and may help in improving metabolic outcomes and reducing cardiovascular risk. Hence, the present study was undertaken to determine the prevalence of hypothyroidism in patients with metabolic syndrome.[10]

MATERIALS AND METHODS

The present study was conducted in the Department of General Medicine at GMERS Medical College and Hospital, Himmatnagar, Gujarat. It was designed as a hospital-based observational cross-sectional study and carried out over a period of 12 months from July 2024 to June 2025. The study population consisted of adult patients attending the outpatient department (OPD) or admitted to the inpatient department (IPD) of the Department of General Medicine who fulfilled the diagnostic criteria for metabolic syndrome.

All adult patients aged between 20 and 60 years who satisfied the diagnostic criteria of metabolic syndrome according to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) guidelines were screened for inclusion in the study. According to these criteria, metabolic syndrome was diagnosed when any three or more of the following five components were present: waist circumference greater than 102 cm in men or greater than 88 cm in women, serum triglyceride level ≥150 mg/dL or treatment for hypertriglyceridemia, HDL-cholesterol level <40 mg/dL in men or <50 mg/dL in women, blood pressure ≥130/85 mmHg or current antihypertensive therapy, and fasting plasma glucose ≥100 mg/dL or previously diagnosed type 2 diabetes mellitus.

Patients aged below 20 years or above 60 years, pregnant women, individuals receiving medications known to influence thyroid function or lipid metabolism such as amiodarone, lithium, antithyroid drugs, levothyroxine, statins, fibrates, or estrogen therapy, patients receiving systemic corticosteroids, individuals with active liver disease or renal dysfunction, and those unwilling or unable to provide informed consent were excluded from the study.

The required sample size for the study was calculated using the hypothesis testing method based on the reported prevalence of hypothyroidism among patients with metabolic syndrome. Considering a prevalence (p) of 23.7%, a confidence level of 95% corresponding to Z = 1.96, and an allowable error of 5%, the minimum calculated sample size was 277. After accounting for a possible 10% non-response rate, a total of 300 participants were included in the final study. All eligible participants were recruited purposively until the required sample size was achieved.

A structured proforma was used to collect demographic details, clinical history, examination findings, and laboratory investigations. A detailed clinical history was obtained from each participant, including age, sex, known medical conditions such as diabetes mellitus, hypertension, and dyslipidemia, and any previous thyroid disorder. Information regarding current medications, lifestyle factors such as smoking and alcohol consumption, level of physical activity, and family history of thyroid disease or metabolic disorders was also recorded. Symptoms suggestive of hypothyroidism including fatigue, weight gain, cold intolerance, constipation, and hair loss were specifically enquired about.

Anthropometric measurements were performed using standard procedures. Height was measured using a calibrated stadiometer with the participant standing barefoot and maintaining the Frankfurt plane. Weight was measured using a calibrated digital weighing scale, and body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Waist circumference was measured with a non-stretchable measuring tape placed horizontally at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest while the participant was standing upright. Blood pressure was recorded in the sitting position after the participant had rested for at least five minutes using a standard sphygmomanometer. Two readings were obtained at one-minute intervals, and the average value was taken as the final measurement.

For laboratory investigations, fasting venous blood samples were collected after an overnight fast of 8–12 hours. Fasting plasma glucose levels were measured using the glucose oxidase enzymatic method. Lipid profile parameters including triglycerides, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, and total cholesterol were analyzed using enzymatic colorimetric methods in the hospital laboratory. Thyroid function tests included serum thyroid-stimulating hormone (TSH), free triiodothyronine (FT3), and free thyroxine (FT4), which were measured using a fully automated chemiluminescent immunoassay platform following standard laboratory procedures.

Thyroid status was categorized based on biochemical parameters using established reference ranges. A euthyroid state was defined by TSH levels between 0.4 and 4.5 mIU/L with FT4 levels between 0.8 and 1.8 ng/dL and FT3 levels between 2.3 and 4.2 pg/mL. Subclinical hypothyroidism was defined as TSH levels greater than 4.5 mIU/L with FT4 and FT3 levels within the reference range. Overt hypothyroidism was defined as TSH levels greater than 4.5 mIU/L with FT4 levels below 0.8 ng/dL irrespective of FT3 levels.

The primary outcome of the study was to determine the prevalence of hypothyroidism among patients with metabolic syndrome. The secondary outcome was to assess the association between hypothyroidism and individual components of metabolic syndrome. Ethical approval for the study was obtained from the Institutional Ethics Committee. All participants were provided with a participant information sheet in their native language, and written informed consent was obtained before enrolment. Confidentiality and privacy of the participants were maintained throughout the study.

Data collected were entered and analyzed using Epi Info software (CDC version 7). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The independent Student's t-test was used to compare continuous variables between groups, and the chi-square test was applied to assess associations between categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The study included a total of 300 patients diagnosed with metabolic syndrome. Table 1 shows the age distribution of the study participants. The mean age of the study population was 47.22 ± 13.18 years. The largest proportion of patients belonged to the 31–40 years age group with 88 individuals (29.3%), followed closely by the 41–50 years group with 86 individuals (28.7%). Patients aged 51–60 years accounted for 74 participants (24.7%), whereas the 20–30 years group comprised 52 patients (17.3%). Overall, the results demonstrate that the majority of patients with metabolic syndrome were concentrated in the middle-aged groups.

Table 2 presents the gender distribution of the study participants. The study population showed equal representation of both genders. Out of 300 participants, 150 were males (50.0%) and 150 were females (50.0%). This indicates that metabolic syndrome in the present study affected both genders equally without any predominance.

Table 3 describes the lifestyle characteristics and family history among patients with metabolic syndrome. Smoking was reported in 172 participants (57.3%), while alcohol consumption was noted in 150 participants (50.0%). A positive family history of thyroid disease was present in 152 participants (50.7%). Regarding physical activity levels, 112 participants (37.3%) had a sedentary lifestyle, 108 participants (36.0%) were physically active, and 80 participants (26.7%) had moderate levels of physical activity. These findings suggest that a large proportion of the study population had lifestyle risk factors such as smoking and sedentary behavior.

Table 4 summarizes the laboratory parameters among the study participants. The mean fasting plasma glucose level was 128.71 ± 29.03 mg/dL. Lipid profile analysis revealed a mean HDL cholesterol level of 41.20 ± 6.92 mg/dL and a mean triglyceride level of 201.26 ± 46.00 mg/dL. The mean total cholesterol level was 215.26 ± 39.09 mg/dL, reflecting a dyslipidemic metabolic profile typical of patients with metabolic syndrome.

Table 5 shows the thyroid function profile among patients with metabolic syndrome. The mean serum TSH level was 7.71 ± 3.71 µIU/mL with a range of 0.6–14.9 µIU/mL. The mean free T3 level was 3.01 ± 0.85 pg/dL with a range of 1.1–6.8 pg/dL, while the mean free T4 level was 0.94 ± 0.36 ng/dL with a range of 0.2–2.1 ng/dL. These findings indicate that many patients with metabolic syndrome exhibited elevated TSH levels suggestive of thyroid dysfunction.

Table 6 presents the prevalence of hypothyroidism among the study participants. Hypothyroidism was present in 216 patients (72.0%), while 84 patients (28.0%) were euthyroid. Among those with hypothyroidism, 85 patients (39.4%) had subclinical hypothyroidism and 131 patients (60.6%) had overt hypothyroidism. These findings indicate a remarkably high prevalence of thyroid dysfunction among individuals with metabolic syndrome in the present study.

Table 1: Age Distribution of Study Participants

Age group (years)	Number	Percentage
20–30	52	17.3%
31–40	88	29.3%
41–50	86	28.7%
51–60	74	24.7%

Table 2: Gender Distribution of Study Participants

Gender	Number	Percentage
Male	150	50.0%
Female	150	50.0%

Table 3: Lifestyle Factors and Family History

Variables	Number	Percentage
Smoking	172	57.3%
Alcohol use	150	50.0%
Family history of thyroid disease	152	50.7%
Physical activity – Active	108	36.0%
Physical activity – Moderate	80	26.7%
Physical activity – Sedentary	112	37.3%

Table 4: Laboratory Parameters among Study Participants

Parameter	Mean ± SD
Fasting glucose (mg/dL)	128.71 ± 29.03
HDL cholesterol (mg/dL)	41.20 ± 6.92
Triglycerides (mg/dL)	201.26 ± 46.00
Total cholesterol (mg/dL)	215.26 ± 39.09

Table 5: Thyroid Function Profile among Study Participants

Parameter	Mean ± SD	Range	Reference values
TSH (µIU/mL)	7.71 ± 3.71	0.6–14.9	0.4–4.5 mIU/L
Free T3 (pg/dL)	3.01 ± 0.85	1.1–6.8	2.3–4.2 pg/dL
Free T4 (ng/dL)	0.94 ± 0.36	0.2–2.1	0.8–1.8 ng/dL

Table 6: Prevalence of Hypothyroidism among Study Participants

Thyroid Status	Number	Percentage
Hypothyroid	216	72.0%
Subclinical hypothyroidism	85	39.4%
Overt hypothyroidism	131	60.6%
Euthyroid	84	28.0%

DISCUSSION

The present study aimed to determine the prevalence of hypothyroidism among patients with metabolic syndrome and to examine its relationship with metabolic abnormalities. In this hospital-based cross-sectional study involving 300 patients diagnosed with metabolic syndrome, hypothyroidism was detected in 216 participants (72.0%), while only 84 participants (28.0%) were euthyroid. Among those with hypothyroidism, 85 patients (39.4%) had subclinical hypothyroidism and 131 patients (60.6%) had overt hypothyroidism. These findings demonstrate a remarkably high prevalence of thyroid dysfunction among individuals with metabolic syndrome, highlighting the importance of evaluating thyroid function in patients presenting with metabolic abnormalities. Recent clinical investigations have increasingly emphasized the close pathophysiological relationship between thyroid dysfunction and metabolic syndrome, particularly due to the influence of thyroid hormones on lipid metabolism, insulin sensitivity, and energy expenditure.[11]

Age distribution in the present study revealed that the majority of patients were in the middle-aged group, with the highest proportion observed in the 31–40 year age category (29.3%) followed by the 41–50 year group (28.7%). Patients aged 51–60 years accounted for 24.7% of the study population, while the 20–30 year group represented 17.3%. This pattern suggests that metabolic syndrome is predominantly observed among middle-aged adults, which is consistent with epidemiological observations indicating that metabolic disturbances tend to increase with age due to changes in hormonal regulation, adiposity, and metabolic activity. Previous research has shown that the prevalence of metabolic syndrome and associated endocrine disorders increases progressively with advancing age because of cumulative metabolic stress and insulin resistance.[12]

Gender distribution in the present study demonstrated equal representation of males and females, with each group comprising 150 participants (50%). Hypothyroidism was observed in both genders without a marked difference in distribution. Although several studies report a higher prevalence of thyroid dysfunction among females, particularly due to autoimmune thyroid disorders, recent evidence suggests that metabolic syndrome-associated thyroid dysfunction can affect both genders significantly. The equal gender distribution observed in this study may reflect the hospital-based nature of the study population and the high prevalence of metabolic risk factors among both men and women.[13]

Lifestyle factors also played an important role in the metabolic profile of the study population. Smoking was reported by 57.3% of participants, while alcohol consumption was present in 50% of individuals. Additionally, a sedentary lifestyle was observed in 37.3% of the study population, indicating a substantial burden of modifiable behavioral risk factors. Sedentary lifestyle and unhealthy habits contribute to obesity, insulin resistance, and dyslipidemia, which are key components of metabolic syndrome. Evidence suggests that lifestyle-related metabolic disturbances may also influence thyroid hormone metabolism through inflammatory pathways and adipokine dysregulation, thereby increasing the likelihood of thyroid dysfunction in individuals with metabolic syndrome.[14]

The biochemical profile of the participants revealed characteristic metabolic abnormalities. The mean fasting plasma glucose level in the study population was 128.71 ± 29.03 mg/dL, indicating impaired glucose metabolism among many participants. Lipid abnormalities were also evident, with mean triglyceride levels of 201.26 ± 46.00 mg/dL and mean total cholesterol levels of 215.26 ± 39.09 mg/dL. These findings are consistent with the metabolic disturbances typically observed in metabolic syndrome. Thyroid hormones are known to regulate lipid metabolism by influencing hepatic LDL receptor expression, cholesterol synthesis, and triglyceride turnover. In hypothyroidism, reduced thyroid hormone levels lead to decreased lipid clearance and increased circulating lipid concentrations, thereby aggravating the dyslipidemia associated with metabolic syndrome.[15]

The thyroid function profile in this study further supports the association between metabolic syndrome and thyroid dysfunction. The mean serum TSH level was elevated at 7.71 ± 3.71 µIU/mL, while mean FT3 and FT4 levels remained within or near the reference ranges. Elevated TSH levels with relatively preserved FT3 and FT4 values suggest a significant burden of both subclinical and overt hypothyroidism among the participants. This observation aligns with recent endocrinological research indicating that even mild thyroid hormone deficiency can adversely affect metabolic processes such as glucose regulation, lipid metabolism, and vascular function. Consequently, the coexistence of hypothyroidism and metabolic syndrome may significantly increase the risk of cardiovascular disease and metabolic complications.

Overall, the findings of the present study demonstrate a strong coexistence between metabolic syndrome and hypothyroidism. The high prevalence observed in this study emphasizes the need for routine thyroid function screening among patients with metabolic syndrome. Early identification and management of thyroid dysfunction may contribute to improved metabolic control and may help reduce long-term cardiovascular risk among affected individuals.

CONCLUSION

The present study demonstrates a high prevalence of hypothyroidism among patients with metabolic syndrome, with more than two-thirds of participants exhibiting thyroid dysfunction. Both subclinical and overt hypothyroidism were commonly observed, indicating that thyroid abnormalities are strongly associated with metabolic disturbances. The study also highlights the presence of significant metabolic abnormalities including dyslipidemia, impaired glucose metabolism, and sedentary lifestyle factors among patients with metabolic syndrome. These findings emphasize the importance of routine thyroid function screening in individuals with metabolic syndrome to facilitate early detection and appropriate management of thyroid dysfunction. Early diagnosis and treatment of hypothyroidism may help improve metabolic parameters and reduce the risk of cardiovascular complications in this high-risk population.

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