ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 17, Issue 3, 2024

Online - 2455-3891
Print - 0974-2441

Research Article

THYROID FUNCTION ABNORMALITIES AND LIPID PROFILE OF PATIENTS WITH METABOLIC SYNDROME: A CROSS-SECTIONAL STUDY

TASO BEYONG*, RATAN RAM

Department of Internal Medicine, Tomo Riba Institute of Health and Medical Sciences, Naharlagun, Arunachal Pradesh, India.
***Corresponding author: Taso Beyong; Email: beyongtaso3@gmail.com**

Received: 04 January 2024, Revised and Accepted: 16 February 2024

ABSTRACT

Objective: The objective was to study the prevalence of thyroid function abnormalities and lipid profile in cases with metabolic syndrome.

Methods: We conducted this observational cross-sectional study of 80 patients with metabolic syndrome to analyze their thyroid functions and lipid profile. The study was conducted in the department of general medicine of a tertiary care medical institute. Individuals fulfilling the National Cholesterol Education Program Adult Treatment Panel III criteria for metabolic syndrome were included in this study on the basis of a predefined inclusion and exclusion criteria. Demographic details were noted. A detailed history was taken and a clinical examination was done. Thyroid function test and lipid profile were done in all cases. The presence of thyroid function and lipid profile abnormalities was analyzed. Statistical analysis was done using SPSS 21.0 software and $p<0.05$ was taken as statistically significant.

Results: Out of these 80 cases, there were 43 (53.75%) males and 37 (46.25%) females with a M: F ratio of 1:0.86. The mean age of male and female patients was comparable with no statistically significant difference (p=0.3739). Analysis of thyroid functions showed that 48.75% of patients were euthyroid, 35% had subclinical hypothyroidism, and 16.25% had clinical hypothyroidism. Notably, euthyroid patients had more stable lipid profiles with a total cholesterol mean of 189.45 mg/dL and triglycerides at 162.65 mg/dL. In contrast, patients with clinical hypothyroidism showed significant lipid disturbances, including total cholesterol of 249.87 mg/dL and triglycerides at 274.42 mg/dL.

Conclusion: Thyroid dysfunction and dyslipidemia are common occurrence in patients with metabolic syndrome. Also, individuals with metabolic syndrome, particularly if they have coexistent thyroid dysfunction are at increased risk of developing significant dyslipidemia. It is therefore important to monitor thyroid functions and lipid profile of individuals with metabolic syndrome.

Keywords: Metabolic syndrome, Thyroid function abnormalities, Dyslipidemia, Follow-up.

 DOI: http://dx.doi.org/10.22159/ajpcr.2024v17i3.51192. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

The rise in obesity rates is as emerging public health problem which is precipitated by factors such as increased caloric intake, consumption of junk food, and sedentary lifestyles. Obesity is a well-known risk factor for numerous chronic diseases, including cardiovascular disease, diabetes as well as various forms of cancer. Obesity is also closely linked with the development of metabolic syndrome which by definition is a cluster of conditions that significantly increase the risk of developing these diseases. The exponential increase in the prevalence of obesity underscores the urgency of understanding and mitigating the health risks associated with obesity [1].

Metabolic syndrome is a complex disorder defined by a cluster of clinical and metabolic factors that directly increase the risk of cardiovascular disease and type 2 diabetes mellitus. Essential components of metabolic syndrome include (any 3 of the following) central obesity (waist circumference ≥102 cm [40 in] in men or ≥88 cm [35 in] in women), hypertension (blood pressure ≥130/85 mm Hg), dyslipidemia (elevated triglycerides and low high-density lipoprotein [HDL] cholesterol levels), and impaired glucose tolerance (fasting glucose ≥100 mg/dL) [2]. Predisposing factors for metabolic syndrome include genetic predispositions, obesity, advancing age, and lifestyle choices such as diet and physical activity levels. The pathophysiology of metabolic syndrome involves insulin resistance, adipose tissue dysfunction, and chronic inflammation. All these factors collectively contribute to clinical manifestations of metabolic syndrome [3].

The consequences of metabolic syndrome extend far beyond mere cardiovascular risk. Metabolic syndrome is closely associated with a variety of complications including increased incidence of type II diabetes mellitus, chronic kidney disease, fatty liver, polycystic ovarian syndrome, obstructive sleep apnea, and increased risk of coronary artery disease. These complications are often interrelated and act by exacerbating one another and leading to a decreased quality of life and increased mortality [4].

There is a significant correlation between metabolic syndrome and endocrine abnormalities, particularly involving thyroid hormones. Thyroid hormones play a vital role in metabolism, thermogenesis, and cardiovascular health [5]. The most frequent thyroid function irregularity among individuals with metabolic syndrome is reported to be subclinical hypothyroidism. Typically, the majority of these patients do not exhibit overt thyroid-related symptoms. However, thyroid function screenings often reveal subclinical hypothyroidism characterized by elevated thyroid stimulating hormone (TSH) levels with normal levels of free triiodothyronine (FT3) and free thyroxine (FT4). Hypothyroidism, even if subclinical, can worsen dyslipidemia associated with metabolic syndrome thereby increasing the risk of serious cardiovascular complications [6]. The hypothyroid state, even at subclinical levels, is associated with reduced clearance of low-density lipoprotein (LDL) and alterations in the levels of HDL, leading to increased total cholesterol and LDL cholesterol concentrations. This exacerbation of dyslipidemia in metabolic syndrome patients with thyroid dysfunction can enhance the atherogenic profile, thereby elevating cardiovascular risk [7].

Thyroid dysfunction can amplify cardiovascular risks, exacerbate insulin resistance, and lead to a poorer metabolic profile in these patients [8]. These thyroid function abnormalities can exacerbate or even contribute to the pathogenesis of metabolic syndrome, suggesting a bidirectional relationship between thyroid dysfunction and metabolic disturbances. Given the prevalence of thyroid function abnormalities in patients with metabolic syndrome, it is crucial to screen these individuals for thyroid disorders. Early detection and appropriate intervention of thyroid dysfunction in the course of metabolic syndrome can potentially reduce the progression of related complications [9].

Despite the established associations between metabolic syndrome and thyroid dysfunction as well as dyslipidemia, there remains a significant gap in the current research particularly with respect to the prevalence and nature of thyroid abnormalities within this patient population. We therefore undertook this cross-sectional study to analyze the prevalence of thyroid function abnormalities and lipid profile in patients having metabolic syndrome.

METHODS

This was a cross-sectional study comprising of 80 adult patients having metabolic syndrome. The study was conducted in the department of general medicine of a tertiary care medical institute. The sample size for this study was determined based on a pilot study examining thyroid functions in individuals with metabolic syndrome. To achieve a power of 90% and a confidence interval of 95%, minimum sample size was 70 patients, therefore, we included 80 patients in our research. Diagnosis of metabolic syndrome was made on the basis of as per the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) [10] criteria if any three of the following features were present: (1) Waist circumference more than 40 inches in men and 35 inches in women, (2) elevated triglycerides 150 milligrams per deciliter of blood (mg/dL) or greater, (3) reduced HDL cholesterol (HDL-C) <40 mg/dL in men or <50 mg/dL in women, (4) elevated fasting glucose of l00 mg/dL or greater, and (5) blood pressure values of systolic 130 mmHg or higher and/or diastolic 85 mmHg or higher.

A comprehensive history was collected for all participants in the study, covering details such as age, sex, any medications being taken, levels of physical activity, surgical history, dietary patterns, and overall lifestyle. In addition, key physical measurements were recorded for each individual, including height and weight, from which body mass index was calculated. We also assessed critical health markers for each participant, noting fasting blood glucose levels, blood pressure, triglyceride levels, HDL-C, and waist circumference.

Thyroid function tests were performed to measure levels of FT3, FT4, and TSH. Blood samples were collected in the morning before breakfast to ensure accuracy in these tests. The established reference ranges used to identify subclinical and clinical hypothyroidism were 0.9–2.4 ng/dL for FT3, 5.5–12.4 ng/dL for FT4, and 0.6–5.9 lU/mL for TSH [11]. Participants were then classified based on their thyroid function test results and any clinical signs they presented. Those with elevated TSH levels but normal FT3 and FT4 levels were diagnosed with subclinical hypothyroidism, while those with elevated TSH and decreased FT3 and FT4 levels were considered to have clinical hypothyroidism. This classification took into account both the biochemical test results and the clinical presentation of each patient. The correlation of thyroid function abnormalities and lipid profile was also done.

Statistical analysis was done using SPSS version 21.0 Software. Quantitative data were presented as mean and standard deviation. Qualitative data were presented with incidence and percentage tables. For quantitative data, an unpaired t-test will be applied and for qualitative data, Chi-square test was used. $p<0.05$ will be taken as statistically significant.

Inclusion criteria

The following criteria were included in the study:

1. Patients having metabolic syndrome according to the NCEP ATP III
2. Individuals above 18 years of age
3. Those who gave written consent for inclusion in the study.

Exclusion criteria

The following criteria were excluded from the study

1. Age <18 years
2. Refusal to give consent
3. Pregnant women
4. Known cases of hypothyroidism, hyperthyroidism, or autoimmune thyroid disorders
5. Patients on drugs known to affect thyroid hormone levels such as amiodarone, lithium compounds, long-term corticosteroids, and bromocriptine.

RESULTS

In this study of individuals with metabolic syndrome, 80 patients were included in the study. Out of these 80 cases, there were 43 (53.75%) males and 37 (46.25%) females with a M: F ratio of 1:0.86 (Fig. 1).

The age distribution showed a concentration of males in the 41–50 age group, accounting for 26.25% of the total, while females were more concentrated in the over 50 age group, representing 18.75% of the total. Both groups had a smaller presence in the youngest age group of 18–30 years. The mean age of the male patients was 49.32±13.92 years and for female patients, it was 49.26±15.48. Statistical analysis revealed no significant difference in the mean ages between genders, with a $p=0.3739$ indicating a high degree of age similarity across the groups (Table 1).

Thyroid function test was done in all cases. Thirty-nines (48.33%) patients were having normal thyroid functions. Subclinical

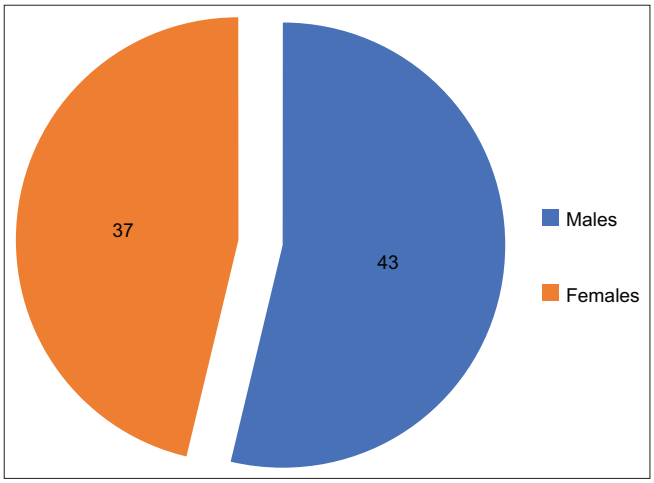

Fig. 1: Gender distribution of the studied cases

Table 1: Gender-wise distribution of age groups

Age group	Males		Females	
	No of patients	Percentage	No of patients	Percentage
18–30 years	4	5.00	2	2.50
31–40 years	6	7.50	6	7.50
41–50 years	21	26.25	14	17.50
>50 years	12	15.00	15	18.75
Total	43	53.75	37	46.25
	Mean age: 46.32±13.92		Mean age: 49.26±15.48	

p=0.3739 (not significant)

hypothyroidism was identified in 24 (30%) patients whereas clinical hypothyroidism was present in 16.67% of the patients. Notably, there were no cases of subclinical or clinical hyperthyroidism recorded in the study (Table 2).

In the euthyroid group, the mean T3 was 1.62 ng/mL with a standard deviation of 0.72, the mean T4 was 10.1 μg/dL with a standard deviation of 3.2, and the mean TSH was 3.8 μIU/mL with a standard deviation of 1.9. For those with subclinical hypothyroidism, there were a mean T3 of 1.32±0.68 ng/dL and a mean T4 of 6.42±2.4 ng/dL. Mean TSH levels were significantly elevated at 12.44±5.4 μIU/mL. In cases of clinical hypothyroidism, there was a notably lower mean T3 at 0.60±0.28 ng/dL, mean T4 at 4.2±2.26 ng/dL, and a markedly higher mean TSH at 36.92±12.36 μIU/mL. There were no cases of subclinical or clinical hyperthyroidism in the study (Table 3).

The analysis of cases on the basis of signs and symptoms showed that fatigue was the most common symptom experienced by 31 patients, accounting for 38.75% of the patients followed by skin changes in 29 patients (36.25%). Constipation and weight gain were also prevalent, affecting 25% and 21.25% of the patients, respectively. Less frequent were menstrual irregularities and pallor, noted in 11.25% and 15% of the cases. The least common symptoms were hair loss, depression or psychological problems, and pedal edema, each affecting <10% of the participants (Table 4).

Analysis of lipid profile in studied cases showed that euthyroid patients exhibited relatively stable lipid measurements, with mean total cholesterol of 189.45 mg/dL, mean LDL cholesterol of 119.78 mg/dL, and mean HDL-C of 38.98 mg/dL. Mean triglyceride level in euthyroid patients was found to be 162.65 mg/dL. Those diagnosed with subclinical hypothyroidism showed higher levels, where total cholesterol was 219.32 mg/dL, LDL cholesterol was 139.54 mg/dL, HDL-C was reduced to 34.76 mg/dL, and triglycerides increased to 199.78 mg/dL. The most pronounced lipid disruptions were recorded in clinical hypothyroidism patients who had total cholesterol at 249.87 mg/dL, LDL at 159.33 mg/dL, significantly lower HDL at 24.48 mg/dL, and the highest triglycerides at 274.42 mg/dL, indicating significant impact of thyroid dysfunction on lipid profile of individuals with metabolic syndrome (Table 5).

Table 2: Thyroid function status in studied cases

Thyroid function status	Number of patients	Percentage
Euthyroid	39	48.75
Subclinical hypothyroidism	28	35.00
Clinical hypothyroidism	13	16.25
Subclinical hyperthyroidism	0	0.00
Hyperthyroidism	0	0.00
Total	80	100

Table 3: Mean T3, T4, and mean TSH of studied cases

Thyroid function status	Mean T3	Mean T4	Mean TSH
Euthyroid	1.62±0.72	10.1±3.2	3.8±1.9
Subclinical hypothyroidism	1.32±0.68	6.42±2.4	12.44±5.4
Clinical hypothyroidism	0.60±0.28	4.2±2.26	36.92±12.36
Subclinical hyperthyroidism	-	-	-
Hyperthyroidism	-	-	-

TSH: Thyroid-stimulating hormone

Table 4: Signs and symptoms in individuals with metabolic syndrome

Signs and symptoms	Number of patients	Percentage
Weakness	31	38.75
Weight gain	17	21.25
Constipation	20	25.00
Skin changes	29	36.25
Hair loss	7	8.75
Depression or psychological problems	4	5.00
Menstrual irregularities	9	11.25
Pallor	12	15.00
Pedal edema	4	5.00

*Some patients had more than 1 sign/symptom

DISCUSSION

In this study of 80 patients with metabolic syndrome, thyroid functions and lipid profiles were analyzed. Out of these 80 cases, there were 43 (53.75%) males and 37 (46.25%) females with a M: F ratio of 1:0.86. The mean age of the male patients was 49.32±13.92 years and for female patients, it was 49.26±15.48. Hattori *et al*., conducted a study to analyze gender differences in lifestyle factors associated with metabolic syndrome and preliminary metabolic syndrome in the general population [12]. For this purpose, the authors examined waist circumference, blood pressure, fasting blood sugar, and various lifestyle factors in 3,166 cases from 30 to 79 years. The authors found that men had a significantly higher prevalence of MetS than women. An age-adjusted logistic regression analysis revealed that heavy drinking and fast eating were associated with an increased probability of MetS in men. Similar male preponderance in cases of metabolic syndrome was also reported by the authors such as Chang *et al*. [13] and Wang *et al*. [14].

In this study, 39 (48.33%) patients were having normal thyroid functions. Subclinical hypothyroidism was identified in 24 (30%) patients whereas clinical hypothyroidism was present in 16.67% of the patients. Fatigue was the most common symptom experienced by 31 patients, accounting for 38.75% of the patients followed by skin changes in 29 patients (36.25%). Khatiwada *et al*. conducted a study to measure glucose, triglyceride, HDL-C, and thyroid hormones in patients with metabolic syndrome [15]. Thyroid dysfunction was seen in 31.9% (n=54) metabolic syndrome patients. Subclinical hypothyroidism (26.6%) was the major thyroid dysfunction, followed by overt hypothyroidism (3.5%) and subclinical hyperthyroidism (1.7%). The findings of our study were similar to this study except for the finding of subclinical hyperthyroidism which was not seen in any case in our study. Similar thyroid dysfunction in cases of metabolic syndrome was also reported by Deshmukh *et al*. [16] and Gyawali *et al*. [17].

The study on thyroid function abnormalities and lipid profiles in patients with metabolic syndrome revealed that patients with subclinical and clinical hypothyroidism exhibit progressively worse lipid profiles, characterized by elevated levels of total cholesterol, LDL cholesterol, and triglycerides, along with reduced HDL-C. This suggests that even mild thyroid dysfunction could substantially impact

Table 5: Correlation of lipid profile and thyroid function test in metabolic syndrome

Thyroid function status	Mean total cholesterol (mg/dL)	Mean LDL cholesterol (mg/dL)	Mean HDL cholesterol (mg/dL)	Mean triglycerides (mg/dL)
Euthyroid	189.45±29.82	119.78±24.65	38.98±12.76	162.65±52.84
Subclinical hypothyroidism	219.32±35.43	139.54±30.21	34.76±10.98	199.78±82.92
Clinical hypothyroidism	249.87±40.58	159.33±35.27	24.48±9.12	274.42±94.98

LDL: Low-density lipoprotein, HDL-C: High-density lipoprotein cholesterol

lipid metabolism, potentially increasing cardiovascular risk in these patients. Abha *et al*., conducted a study to find the association of thyroid function with lipid profile in patients with metabolic syndrome [18]. In a study comparing individuals with and without metabolic syndrome, those with the syndrome exhibited significantly higher triglycerides and lower HDL-C levels. In addition, TSH levels were also higher in the metabolic syndrome group. Among the various components of metabolic syndrome, waist circumference and HDL-C demonstrated a strong positive correlation with TSH levels. Other factors such as systolic and diastolic blood pressure, along with fasting blood sugar levels, also showed a moderate positive correlation with TSH. The study concluded that there is a significant association of thyroid function with lipid profile in metabolic syndrome. A similar association of thyroid dysfunction and lipid profile was also reported by the authors such as Gutch *et al*. [19] and Rizos *et al*. [20].

CONCLUSION

Thyroid dysfunction and dyslipidemia are a common occurrence in patients with metabolic syndrome. Subclinical hypothyroidism as evidence by increased TSH and normal FT3 and FT4 values was the most common finding. Therefore, it is important to regularly screen patient of metabolic syndrome for thyroid dysfunction. Furthermore, individuals with metabolic syndrome, particularly if they have coexistent thyroid dysfunction, are found to be at increased risk of dyslipidemia making it crucial to monitor their lipid profile and plan appropriate interventions accordingly.

CONFLICTS OF INTEREST

None.

REFERENCES

1. Sørensen TI, Martinez AR, Jørgensen TS. Epidemiology of obesity. Handb Exp Pharmacol. 2022;274:3-27. doi: 10.1007/164_2022_581
2. Ginsberg HN, MacCallum PR. The obesity, metabolic syndrome, and type 2 diabetes mellitus pandemic: Part I. Increased cardiovascular disease risk and the importance of atherogenic dyslipidemia in persons with the metabolic syndrome and type 2 diabetes mellitus. J Cardiometab Syndr. 2009;4(2):113-9. doi: 10.1111/j.1559-4572.2008.00044.x
3. Moller DE, Kaufman KD. Metabolic syndrome: A clinical and molecular perspective. Annu Rev Med. 2005;56:45-62. doi: 10.1146/annurev.med.56.082103.104751
4. Cho LW. Metabolic syndrome. Singapore Med J. 2011;52(11):779-85.
5. Teixeira PF, Dos Santos PB, Pazos-Moura CC. The role of thyroid hormone in metabolism and metabolic syndrome. Ther Adv Endocrinol Metab. 2020;11:1-33. doi: 10.1177/2042018820917869
6. Rastgooye Haghi A, Solhjoo M, Tavakoli MH. Correlation between subclinical hypothyroidism and dyslipidemia. Iran J Pathol. 2017;12(2):106-11.
7. Ruotolo G, Howard BV. Dyslipidemia of the metabolic syndrome. Curr Cardiol Rep. 2002;4(6):494-500. doi: 10.1007/s11886-002-0113-6
8. Srivastava S, Mathur G, Chauhan G, Kapoor P, Bhaskar P, Jain G, *et al*. Impact of thyroid dysfunction on insulin resistance: A study from a tertiary care center in India. J Assoc Physicians India. 2021;69(2):49-53.
9. El-Hay GA, Argoon SA, Mousa NM. Evaluation of the frequency and patterns of thyroid dysfunction in patients with metabolic syndrome. Egypt J Intern Med. 2021;33:24. doi: 10.1186/s43162-021-00054-z
10. Lipsy RJ. The national cholesterol education program adult treatment panel III guidelines. J Manag Care Pharm. 2003;9(1 Suppl):2-5. doi: 10.18553/jmcp.2003.9.s1.2
11. Shokripour M, Imanieh MH, Garayemi S, Omidifar N, Shirazi Yeganeh B, Althabhawee F. Thyroid stimulating hormone, T3 and T4 population-based reference range and children prevalence of thyroid dysfunction: First report from South of Iran. Iran J Pathol. 2022;17(4):427-34. doi: 10.30699/IJP.2022.541736.2812
12. Hattori T, Konno S, Munakata M. Gender differences in lifestyle factors associated with metabolic syndrome and preliminary metabolic syndrome in the general population: The Watari study. Intern Med. 2017;56(17):2253-9. doi: 10.2169/internalmedicine.8578-16
13. Chang SH, Chang YY, Wu LY. Gender differences in lifestyle and risk factors of metabolic syndrome: Do women have better health habits than men? J Clin Nurs. 2019;28(11-2):2225-34. doi: 10.1111/jocn.14824
14. Wang WY, Li CH, Wu YS, Chien WC, Wang KY, Tzeng WC. Gender differences in the prevalence of metabolic syndrome among Taiwanese air force personnel: A population-based study. J Cardiovasc Nurs. 2020;35(5):502-11. doi: 10.1097/JCN.0000000000000714
15. Khatiwada S, Sah SK, Rajendra KC, Baral N, Lamsal M. Thyroid dysfunction in metabolic syndrome patients and its relationship with components of metabolic syndrome. Clin Diabetes Endocrinol. 2016;2:3. doi: 10.1186/s40842-016-0021-0
16. Deshmukh V, Farishta F, Bhole M. Thyroid dysfunction in patients with metabolic syndrome: A cross-sectional, epidemiological, Pan-India study. Int J Endocrinol. 2018;2018:2930251. doi: 10.1155/2018/2930251
17. Gyawali P, Takanche JS, Shrestha RK, Bhattarai P, Khanal K, Risal P, *et al*. Pattern of thyroid dysfunction in patients with metabolic syndrome and its relationship with components of metabolic syndrome. Diabetes Metab J. 2015;39(1):66-73. doi: 10.4093/dmj.2015.39.1.66
18. Abha P, Keshari JR, Sinha SR, Nishant K, Kumari R, Prakash P. Association of thyroid function with lipid profile in patients with metabolic syndrome: A prospective cross-sectional study in the Indian population. Cureus. 2023;15(9):e44745. doi: 10.7759/cureus.44745
19. Gutch M, Rungta S, Kumar S, Agarwal A, Bhattacharya A, Razi SM. Thyroid functions and serum lipid profile in metabolic syndrome. Biomed J. 2017;40(3):147-53. doi: 10.1016/j.bj.2016.12.006
20. Rizos CV, Elisaf MS, Liberopoulos EN. Effects of thyroid dysfunction on lipid profile. Open Cardiovasc Med J. 2011;5:76-84. doi: 10.2174/1874192401105010076