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ORIGINAL RESEARCH

Study of thyroid dysfunction in patients of metabolic syndrome

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Abstract

Background: Metabolic syndrome and thyroid disorders represent significant global health challenges with overlapping metabolic implications. This study was conducted to find the association between metabolic syndrome and thyroid disorders, and to determine the type of thyroid dysfunction in metabolic syndrome.

Materials and Methods: This was a non-randomized cross-sectional study conducted over two years from December 2019 to December 2021. Seventy-five patients who fulfilled the criteria for metabolic syndrome by the International Diabetes Federation (IDF) were included. Detailed history, anthropometric measurements, blood pressure, fasting blood sugar, lipid profile, and thyroid profile (T3, T4, TSH) were assessed.

Results: Out of 75 patients with metabolic syndrome, 27 (36%) had thyroid dysfunction. Subclinical hypothyroidism was the most common (20%), followed by hypothyroidism (13.33%) and subclinical hyperthyroidism (2.67%). The incidence of thyroid dysfunction increased as the number of metabolic syndrome criteria fulfilled increased. There was a significant correlation between thyroid dysfunction and abnormal HDL cholesterol levels, but not with other metabolic syndrome parameters like hypertension, hyperglycemia, or hypertriglyceridemia.

Conclusion: This study found a high prevalence of thyroid dysfunction, particularly subclinical hypothyroidism, among patients with metabolic syndrome. The study highlights the importance of screening for thyroid disorders in patients with metabolic syndrome, as identification and appropriate management of thyroid dysfunction can help improve the metabolic derangements and reduce cardiovascular risk in this population. Further large-scale studies are needed to fully elucidate the complex relationship between thyroid function and the various components of metabolic syndrome.

Key words: Cardiovascular risk, Lipid profile, Metabolic syndrome, Thyroid disorders,

Introduction

Metabolic syndrome and thyroid disorders represent significant global health challenges with overlapping metabolic implications. Recent lifestyle changes, increased consumption of calorie-dense foods, and urbanization have led to a striking rise in metabolic syndrome prevalence.[1] Metabolic syndrome, also termed syndrome X, encompasses central obesity,

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hypertriglyceridemia, low HDL cholesterol, hyperglycemia, and hypertension.[2,3] Similarly, thyroid disorders affect approximately 42 million people in India alone, with women being disproportionately affected.[4] Both conditions significantly impact cardiovascular health through various mechanisms, including insulin resistance and lipid metabolism disturbances.[5] Insulin resistance, particularly marked by increased circulating free fatty acids, plays a central role in metabolic syndrome pathophysiology.[6] Thyroid dysfunction, whether hyper- or hypothyroidism, substantially affects lipoprotein composition and transport.[7] The coexistence of these conditions can exacerbate cardiovascular risks, with low normal FT4 levels being significantly associated with insulin resistance.[8] Understanding this relationship is crucial for healthcare providers, as early intervention and appropriate management can significantly improve patient outcomes.[9,10]

Due to the increasing prevalence of both metabolic syndrome and thyroid disorders, this study is conducted to find the association between metabolic syndrome and thyroid disorders and also to find the type of thyroid dysfunction in metabolic syndrome.

Material and methods

Source of data

Patients attending both outpatient and inpatient Medicine Department in Guru Nanak Dev Hospital, Amritsar. The study was carried out after seeking permission from Institutional Ethics Committee, Government Medical College, Amritsar. Written informed consent was obtained from the patients.

Method of Collection Data

- Sampling Method: Simple Random sampling.
- Study design: Non Randomized Cross Sectional Study.
- Duration: Two years from December 2019 to December 2021.

Sample size: 75 patients were included in this study who fulfill the criteria of metabolic syndrome by IDF were taken in this study

For a person to be defined as having the metabolic syndrome they must have:

Central obesity -defined as waist circumference with ethnicity specific values (for south Asians: ≥90 cm for Men and ≥80cm for women were used, ≥ 94 cm for europoid men and ≥ 80 cm for europoid women

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AND any two of the following:

1. Raised triglycerides: > 150 mg/dL (1.7 mmol/L), or specific treatment for this lipid abnormality.
2. Reduced HDL cholesterol: < 40 mg/dL in males, < 50 mg/dl in females, or specific treatment for this lipid abnormality.
3. Raised blood pressure: systolic BP > 130 or diastolic BP >85 mm Hg, or treatment of previously diagnosed hypertension.
4. Raised fasting plasma glucose :(FPG)>100 mg/dl, or previously diagnosed type 2 diabetes mellitus.

Inclusion criteria

Patients of Age more than 18 years, who fulfilled the criteria for metabolic syndrome by International diabetic foundation [IDF] are to be taken into study

Exclusion criteria

- All patients who are less than 18 years.

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- Patients taking steroids.
- Patients taking any drugs which may alter the thyroid function.
- Patients already diagnosed with overt hypothyroidism / hyperthyroidism.

Method of analysis

The data collected was analysed according to the standard statistical methods to reach a conclusion.

The following information was collected from patients:

- Detailed history
- Anthropometric measurements like: Waist circumference
- Blood pressure (in right upper limb in sitting posture)
- Fasting blood sugar (after 8 hours of fasting)
- Lipid profile
- Thyroid profile: T3, T4, TSH levels

Results

TABLE 1: PERCENTAGE DISTRIBUTION OF TOTAL NUMBER OF MALE AND FEMALE PATIENTS

Age group (years)	Female		Male		Total	
	No.	%age	No.	%age	No.	%age
<=30	10	13.33	4	5.33	14	18.67
31-40	12	16.00	5	6.67	17	22.67
41-50	14	18.67	4	5.33	18	24.00
51-60	10	13.33	7	9.33	17	22.67
>60	2	2.67	7	9.33	9	12.00
Total	48	64.00	27	36.00	75	100.00
Meanage	49.48±16.21		42.27±12.72		44.86±14.39	
p-value	0.036					

TABLE 2: SEX WISE DISTRIBUTION OF TYPE OF THYROID DYSFUNCTION

Thyroid status	Female		Male		Total	
	No.	%age	No.	%age	No.	%age
EUTHYROID	29	38.67	19	25.33	48	64.00
HYPOTHYROID	7	9.33	3	4.00	10	13.33
S/C HYPERTHYROID	2	2.67	0	0.00	2	2.67
S/C HYPOTHYROID	10	13.33	5	6.67	15	20.00
HYPERTHYROID	0	0.00	0	0.00	0	0.00
Total	48	64.00	27	36.00	75	100.00

TABLE 3: AGE WISE DISTRIBUTIION OF THYROID DYSFUNCTION

Age group (years)	Euthyroid		Hypothyroid		Subclinical Hyperthyroid		Subclinical Hypothyroid		Total	
	No.	%age	No.	%age	No.	%age	No.	%age	No.	%age
<=30	9	12.00	2	2.67	0	0.00	3	4.00	14	18.67
31-40	12	16.00	3	4.00	0	0.00	2	2.67	17	22.67
41-50	11	14.67	1	1.33	1	1.33	5	6.67	18	24.00
51-60	9	12.00	3	4.00	1	1.33	4	5.33	17	22.67
>60	7	9.33	1	1.33	0	0.00	1	1.33	9	12.00
Total	48	64.00	10	13.33	2	2.67	15	20.00	75	100.00

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Mean age	45.25±15.24	42.40±13.27	48.00±04.24	44.46±13.93	44.86±14.39
p-value	0.938				

TABLE 4: DISTRIBUTION OF PATIENTS FULFILLING METABOLIC SYNDROME CRITERIA

MS criteria fulfilled	Number of patients
3	29
4	29
5	17

TABLE 5: THE METABOLIC SYNDROME PARAMETER WISE THYROID DYSFUNCTION

MS Criteria	Euthyroid		Hypothyroid		Subclinical Hyperthyroid		Subclinical Hypothyroid		Total	
	No.	%age	No.	%age	No.	%age	No.	%age	No.	%age
3.0	26	34.67	0	0.00	0	0.00	3	4.00	29	38.67
4.0	19	25.33	3	4.00	1	1.33	6	8.00	29	38.67
5.0	3	4.00	7	9.33	1	1.33	6	8.00	17	22.67
Total	48	64.00	10	13.33	2	2.67	15	20.00	75	100.00

X^2:27.491;p=0.001

TABLE 6: RELATIONSHIP BETWEEN EUTHYROID AND SUBCLINICAL HYPOTHYROIDISM WITH RESPECT TO MS PARAMETERS

MS parameters	Euthyroid		Subclinical hypothyroidism		p-value
	Mean	SD	Mean	SD	
WC	106.27	6.69	113.73	8.15	0.001
SBP	145.21	15.51	154.13	11.72	0.045
DBP	92.83	10.38	92.93	5.50	0.972
TG	186.56	38.55	208.53	66.33	0.115
HDL	55.42	9.57	44.20	9.81	0.001
FBS	120.77	51.34	124.20	56.75	0.826

P value<0.05 (significant)

TABLE 7: CORRELATION OF METABOLIC SYNDROME PATIENTS WITH ABNORMAL HDL TO THYROID DYSFUNCTION

HDL	Thyroid				Total	
	Present		Absent			
	No.	%age	No.	%age	No.	%age
Abnormal	23	30.67	14	18.67	21	28.00
Normal	4	5.33	34	45.33	54	72.00
Total	27	36.00	48	64.00	75	100.00

X^2:21.694;p=0.001

TABLE 8: CORRELATION OF METABOLIC SYNDROME PATIENTS WITH HYPERTRIGLYC ERIDEMIA TO THYROID DYSFUNCTION

Triglycerides	Thyroid	Total

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	Present		Absent			
	No.	%age	No.	%age	No.	%age
AB	25	33.33	39	52.00	21	28.00
N	2	2.67	9	12.00	54	72.00
Total	27	36.00	48	64.00	75	100.00

X^2:1.776;p=0.183

TABLE 9: CORRELATION OF METABOLIC SYNDROME PATIENTS WITH FBS TO THYROID DYSFUNCTION

FBS	Thyroid				Total	
	Present		Absent			
	No.	%age	No.	%age	No.	%age
<100	9	12.00	18	24.00	27	36.00
>100	18	24.00	30	40.00	48	64.00
Total	27	36.00	48	64.00	75	100.00

X^2:0.130;p=0.718

TABLE 10: CORRELATION OF METABOLIC SYNDROME PATIENTS WITH HYPERTENSION TO THYROID DYSFUNCTION

HYPERTENSION	Thyroiddysfunction				Total	
	Present		Absent			
	No.	%age	No.	%age	No.	%age
Present	26	34.67	39	52.00	65	86.67
Absent	1	1.33	9	12.00	10	13.33
Total	27	36.00	48	64.00	75	100.00

X^2:3.385;p=0.065

TABLE 11: CORRELATIONOFMETABOLICSYNDROME PATIENTS WITH DIABETES MELLITUS TO THYROID DYSFUNCTION

Diabetes	Thyroid				Total	
	Present		Absent			
	No.	%age	No.	%age	No.	%age
Present	10	13.33	11	14.67	21	28.00
Absent	17	22.67	37	49.33	54	72.00
Total	27	36.00	48	64.00	75	100.00

X^2:1.709;p=0.191

Discussion

In this study, out of 75 patients, 27(36%) of the metabolic syndrome patients had thyroid dysfunction. Subclinical hypothyroidism is the most common occurrence 15 (20%). Results of this study are consistent with the study done by Gyawali P et al[11], as most of the metabolic syndrome patients in their study (29.32%) also had subclinical hypothyroidism. In a study conducted by Nitturkar RK[12] subclinical hypothyroidism was the most common prevalence.

In sex-wise distribution, out of 48 females, 19 females have thyroid dysfunction (39.58%) whereas in males, 8 out of 27 males have thyroid dysfunction (29.62%). These results are comparable with the study done by UzunuluM et al[13] where incidence was 40.7% in females and 12.9% in males.

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The mean age group in the present study is 44.86±14.39 years with 46.67% of patients being in the age group of 40-60 years. This present study is conducted in Punjab where the prevalence of obesity is already very high. An increasing incidence of metabolic syndrome is noticed in the young population with 14 out of 75 individuals (18.67%) being less than 30 years of age. Out of these 14 patients, 3 have subclinical hypothyroidism and 2 over hypothyroidism.

Similarly, the mean age group in the study done by UzunuluM et al[13] in 220 patients with metabolic syndrome was 48.5 ± 11.3 years.It is observed that middle-aged women with metabolic syndrome are at a relatively higher risk to develop metabolic syndrome.

Shantha GP et al[14] conducted a cross-sectional study from a tertiary care hospital in Chennai city involving 420 patients with metabolic syndrome (NCEP – ATP III criteria). He found that out of 420 patients, 92 had subclinical hypothyroidism (21.9%) and 31 had overt hypothyroidism (7.4%). The incidence of subclinical hypothyroidism in their study (21.9%) was found to be similar to this present study (20%).

It was seen over various studies that as the number of metabolic criteria increases, the incidence of thyroid dysfunction increases. These findings are very much consistent with this study (table 5). Out of all the patients with thyroid dysfunction (36%), 18.66% of the patients fulfilled five parameters of metabolic syndrome, whereas 13.3% among patients fulfilled four parameters, and 4% among patients fulfilled 3 parameters.

In the present study, the incidence of thyroid disorder is 30.67% in patients with abnormal HDL (p-value <0.05) and 33.33% in patients with abnormal triglycerides (p value>0.05), suggesting that there is a significant correlation of thyroid dysfunction with HDL levels and nonsignificant correlation with serum triglycerides. The results are contrary as compared to the study by Roos A et al[15] which concluded free T4 (FT4) was significantly associated with total cholesterol, high-density lipoprotein cholesterol ($\beta = 0.100$; $P < 0.001$), and triglycerides ($\beta = -0.102$; $P < 0.001$). These findings are consistent with anincreased cardiovascular risk in subjects with low thyroid function, which is common in metabolic syndrome. Free T4 levels could not be done in the present study because of financial constraints.However,Gyawali P et al[11] found no evidence of a relationship between Thyroid dysfunction and components of metabolic syndrome.

Kim BJ et al[16] demonstrated a relationship between metabolic syndrome/ insulin resistance and low serum free T4 (FT4) level in euthyroid subjects. Thyroid hormone significantly affected each component of metabolic syndrome, there was no association between serum FT4 level and presence of the metabolic syndrome.Reasons for the discrepancy among studies include different criteria used to define the metabolic syndrome and dissimilar sample sizes and characteristics of the populations under study. The present study is conducted in Punjab where prevalence of obesity is already very high.

In the present study, the incidence of thyroid disorder is 34.67% in patients with hypertension (p-value 0.065) suggesting that there is no significant correlation between thyroid disorder and hypertension in patients with metabolic syndrome. However, the relationship between euthyroid and subclinical hypothyroidism with respect to metabolic syndrome parameters significant analysis is observed for waist circumference (p-value 0.001) and HDL (p-value 0.001). Our results were comparable with the study done by UzunuluM etal[13] in Turkish population who also found no significant association of hypertension in metabolic syndrome patients with thyroid dysfunction (p-value 0.137).

In the present study, it was found that the incidence of thyroid disorder is more in patients with FBS > 100mg/dl (24%) as compared to those with FBS<100 mg/dl (12%), which is statistically insignificant. similarly, the correlation of metabolic syndrome patients with diabetes mellitus to thyroid dysfunction when evaluated statistically is found to be insignificant (p-value 0.191).The results were comparable with the study done by Roos A et

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al[15]observed that thyroid dysfunction was not significantly associated with FBS levels. Meher LK et al[17] conducted a cross-sectional study in 100 patients of metabolic syndrome (as per NCEP ATP III criteria) in Orissa and found that fasting blood glucose is not significantly correlated with levels of TSH.

The HUNT[18] study concluded that within the range of TSH that is considered clinically normal, an increasing level of TSH was associated with less favorable lipid concentrations. The association with serum lipids was linear across the entire reference range of TSH. A similar study by Teran-Garcia M and Bouchard C[19] have concluded that TSH values showed a positive correlation (adjusted for age and gender) with total cholesterol, triglycerides, and waist circumference. On the other hand, FT4 concentrations showed a negative correlation with waist circumference, fasting insulin, and a positive correlation with HDL cholesterol. T4 is required for the expression of the LDL receptor gene. They observed a significant association between hypercholesterolemia and subclinical hypothyroidism.

The HYOGA study[20] concluded that subclinical hypothyroidism is frequent in a population of hypercholesterolemic female patients aged 50 or more. quality of life is affected even when TSH is <10 mUI/L and found out thyroxine replacement improved the quality of life. These all support the role of thyroid hormones in the regulation of lipid metabolism.

It is well known fact that treating subclinical hypothyroidism is associated with a reduction in cardiovascular risk and improvement in metabolic parameters. The Tromso study also concluded that lipid levels (LDL & triglyceride) are reduced with thyroxine treatment in subjects with subclinical hypothyroidism.[21]Col NF et al[22] recommend treating sub-clinical hypothyroidism associated with type 2 diabetes and hypertension in his scientific review.

This present study shows that the incidence of thyroid dysfunction in metabolic syndrome patients is higher than in normal subjects. These findings indicate a screening for thyroid dysfunction while managing patients with metabolic syndrome. As shown in many studies, managing thyroid dysfunction is rewarded by improvement of metabolic parameters, reduction in cardiovascular risk, and better quality of life.

Conclusion

This study found a high prevalence of thyroid dysfunction, particularly subclinical hypothyroidism, among patients with metabolic syndrome. The incidence of thyroid dysfunction increased as the number of metabolic syndrome criteria fulfilled increased. There was a significant correlation between thyroid dysfunction and abnormal HDL cholesterol levels, but not with other metabolic syndrome parameters like hypertension, hyperglycemia, or hypertriglyceridemia.

The study highlights the importance of screening for thyroid disorders in patients with metabolic syndrome, as identification and appropriate management of thyroid dysfunction can help improve the metabolic derangements and reduce cardiovascular risk in this population. Further large-scale studies are needed to fully elucidate the complex relationship between thyroid function and the various components of metabolic syndrome.

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