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A cross-sectional analytical study of thyroid dysfunction in metabolic syndrome in a tertiary care center. Viswabharathi Medical College, Kurnool

Dr. S.S. Rama Kalyana Praveen[1] Dr. K. Bala Siddartha[2] Dr. Shamsheer Khan.P[3*], Dr. Vedanth Vasudevan[4] Dr. Beeram Rakesh Prasad[5] Dr.Mohammed Saleem Yousuf[6] Dr. Singamaneni Manideep[7] Dr. Harshini Bethu[8]

[1,2]Assistant Professor, Department of General Medicine, Viswabharathi Medical College, Kurnool, Andhra Pradesh
*[*3] Associate Professor, Department of General Medicine, Viswabharathi Medical College, Kurnool, Andhra Pradesh*
[4,5,6,7,8] Intern, Department of General Medicine, Viswabharathi Medical College, Kurnool, Andhra Pradesh.

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Corresponding Author:

Dr. Shamsheer Khan.P
Associate Professor, Department of General Medicine, Viswabharathi Medical College, Kurnool, Andhra Pradesh
Mail-id: shamsheerkhan788@gmail.com

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ABSTRACT

Background: Metabolic syndrome (MetS) is a cluster of cardiometabolic risk factors linked to increased cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM) risk. Thyroid dysfunction, particularly hypothyroidism, may exacerbate these risks by affecting lipid metabolism, blood pressure, and body weight. Data on this association in India are limited. **Aims and objectives:** To determine the prevalence and types of thyroid dysfunction in MetS patients and evaluate its association with MetS components in a tertiary care setting. **Materials and Methods:** A cross-sectional study was conducted among 85 patients with MetS, diagnosed using International Diabetes Federation (IDF) criteria, at a tertiary care centre in Kurnool, Andhra Pradesh. Thyroid function was assessed by measuring serum T4 and TSH levels. Metabolic parameters, including waist circumference (WC), systolic/diastolic blood pressure (SBP/DBP), fasting blood sugar (FBS), total cholesterol (TC), HDL, and triglycerides (TGL), were recorded. Fischer's exact test and Pearson's correlation were used for statistical analysis. **Results**: Thyroid dysfunction was observed in18.8%of patients, with subclinical hypothyroidism (14.1%) being the most common, followed by overt hypothyroidism (3.5%) and subclinical hyperthyroidism (1.2%). Subclinical hypothyroidism was significantly associated with fulfilling three or more MetS criteria (p=0.002) and was more prevalent in females (83.3%, p=0.049). No significant correlations were found between T4/TSH and MetS components. **Conclusion**: Sub clinical hypothyroidism is prevalent in Indian MetS patients and is associated with more severe MetS profiles, particularly in females. Routine thyroid screening in MetS patients may aid in early identification of cardiovascular risk factors.

Keywords: Metabolic syndrome, Thyroid dysfunction, Subclinical hypothyroidism, Cardiovascular risk, India.

INTRODUCTION

Metabolic syndrome (MetS) is characterized by a constellation of interconnected risk factors, including central obesity, dyslipidemia, hypertension, and impaired glucose tolerance, which collectively elevate the risk of atherosclerotic cardiovascular disease (ASCVD), type 2 diabetes mellitus (T2DM), and chronic kidney disease. [1,2] The global prevalence of MetS is rising, with estimates in Indiareaching30% in2020, driven by urbanization, sedentary lifestyles, and dietary shifts. [3,4] Thyroid hormones play a critical role in regulating metabolism, influencing lipid profiles, glucose homeostasis, and cardiovascular function. [5,6] Thyroid dysfunction, particularly hypothyroidism, is implicated in exacerbating MetS components by promoting dyslipidemia, insulin resistance, and hypertension. [7,8]

Hypothyroidism, both overt and subclinical, is associated with increased serum cholesterol, triglycerides, and low-density lipoprotein (LDL)levels, as well as reduced high-density lipoprotein (HDL) cholesterol, contributing to atherogenesis. [9,10] Sub clinical hypothyroidism, defined by elevated thyroid-stimulating hormone (TSH) levels with normal free thyroxine (T4) and triiodothyronine (T3), is particularly relevant, as it may represent an early stage of thyroid dysfunction with

significant metabolic implications. [11] Previous studies have reported a higher prevalence of subclinical hypothyroidism in MetS patients, with TSH levels at the upper limit of the normal range correlating with obesity, hyper triglyceridemia, andMet Srisk.[12,13]Further more, thyroid hormones influence blood pressure regulation through effects on cardiac output, vascular resistance, and sympathetic nervous system activity, potentially compounding hypertension in MetS.[14,15]

Aim of the study

Despite these associations, data on thyroid dysfunction in MetS patients in India, particularly in rural and semi-urban populations, are limited. This study aimed to investigate the prevalence and types of thyroid dysfunction in MetS patients attending a tertiary care center Kurnool District and to assess their associations with MetS components. By elucidating these relationships, we seek to inform clinical strategies for early detection and management of thyroid dysfunction to reduce cardiovascular risk in MetS patients.

METHODOLOGY

Study subjects: Patients visiting Out Patient Department in Department of General Medicine, Viswabharathi Medical College, Kurnool who satisfy the inclusion criteria.

Study design: Cross sectional Analytical study.

Sampling method: Consecutive sampling method.

Study period:18months from January 2024 to June2025

Sample size: According to Navin B, K.E. Arumugam et al study [30] considering the prevalence of thyroid dysfunction in patients with metabolic syndrome as 16.7% with a precision of 8% and 95% confidence interval, the sample size is calculated as

$N = Z^2 * p * (1-p)/d2$

Z1-α/2-two tailed probability for 95% confidence interval=1.96

p (%) - prevalence of thyroid dysfunction in patients with metabolic syndrome = 0.167d(%) - precision or allow able error for thyroid dysfunction in patients with MetS =0.08 N = 1.96^2 * 0.167 * (1 - 0.167) / 0.08^2

N=83.5.

Then sample size rounded to 85.

Study setting

Department of General Medicine, Viswabharathi Medical College, a tertiary care hospital,

Sampling procedure

After ethical approval, eligible participants from the General Medicine OPD were enrolled with informed consent. Medical history, anthropometric measurements (height, weight, waist circumference), and seated blood pressure were recorded. Fasting blood samples were analyzed for glucose, lipid profile, and thyroid function using semi-automated and automated analyzers. Waist circumference was measured midway between the lowest rib and iliac crest during normal expiration. Blood pressure was reassessed after15 minutes of rest in supine position with the cuff at heart level. Laboratory analyses included enzymatic methods for glucose/lipids and chemiluminescence immunoassay for thyroid hormones**.**

Inclusión criteria:

Patients fulfilling the Any three of the following criteria of NCEPATPIII.[31]

Impaired Glucose Tolerance (IGT)	Fasting plasma glucose ≥110mg/dl (6.1mmol/L)
Abdominal Obesity	Waist Circumference >102cm (40 inches) in men >88 cm(35inches) in women
Hypertriglyceridemia	≥150mg/dl (1.7mmol/L) or drug treatment for high triglycerides
Low levels of HDL	<40 mg/dl (1 mmol/L) in men<50 mg/dl (1.3 mmol/L in women or on drug treatment for low HDL
Hypertension	≥130/85mmHg or drug treatment for hypertension

Exclusion criteria

- Age less than 30 and above 70years.

- Pregnant females.
- Patients with Cardiovascular disorder
- Iodine deficient individuals.
- Patient taking medications for diabetes mellitus, hypertension, thyroid disorders, dyslipidaemia.
- Patients who were not giving concent.

DataCollection

Demographic data, including age and gender, were recorded. Anthropometric measurements, such as height, weight, and waist circumference, were obtained using standardized techniques. Blood pressure was measured using a calibrated sphygmomanometer. Fasting blood samples were collected to assess fasting blood sugar (FBS),total cholesterol, HDL cholesterol, triglycerides, and thyroid function tests(T4andTSH).Thyroid function status was categorized as euthyroid (normal T4 and TSH), hypothyroidism (TSH >10 mU/L with low T4), subclinical hypothyroidism (TSH 4.5–10 mU/L with normal T4), or subclinical hyperthyroidism (TSH 0.1–0.4 mU/L with normal T4 [17, 18]

StatisticalAnalysis

Descriptive statistics, including means, standard deviations, medians, and percentages, were calculated for continuous and categorical variables. Fisher's exact test was used to assess associations between thyroid function status, gender, age categories. A p-value <0.05 was considered statistically significant. Statistical analyses were performed using software SPSS version 25**.**

Ethical Considerations

The study was approved by the Institutional Ethics Committee of Viswabharathi Medical College a tertiary care hospital. Kurnool, Andhra Pradesh, South India. Written informed consent was obtained from all participants, and data confidentiality was maintained in accordance with ethical guidelines.

RESULTS

The study included 85 patients (58.8%male, 41.2%female)

Fig1: Gender distribution among study subjects (N=85)

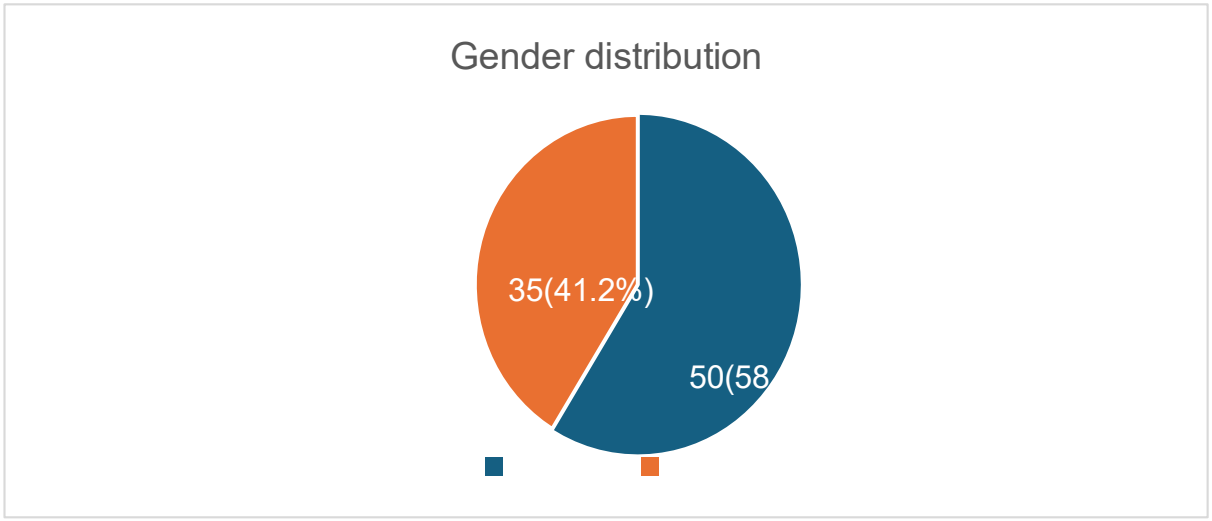

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Table1: Descriptive statistics of age among study population(N=85)

Parameter	Age in years
Mean	44.13
Median	43.00
Mode	40
Std.Deviation	8.806
Minimum	21
Maximum	67

Table no.1shown that mean±SD among study population was 44.13 years±8.81.The minimum age studied was 21 years and maximum 67 years.

Fig 2: Age & gender distribution among study population(N=85)

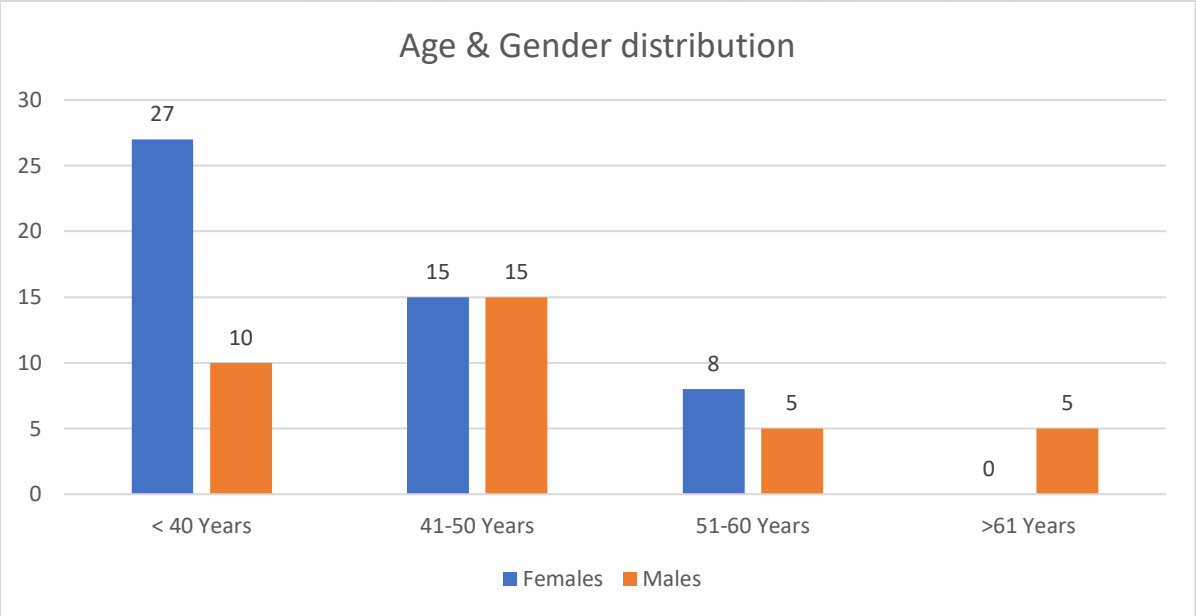

Fig no. 2 shown that 37out of 85(43.5%) study subjects belonged to <40 years of age group out of which 27(73%) were females and 10(27%) were males. 30 of 85 (35.3%) belonged to 41-50 years with 15 males and 15 females. 13 (15%) belonged to 51 to 60 years with 8 females and 5 males. 5 (5.9%) belonged to >61 years and all were males.

Table2: Descriptive Statistics of Metabolic Parameters (N=85)

Parameter	Height (cm)	Weight (kg)	Waist Circumference (cm)
Mean	158.46	70.46	96.69
Median	159	70	96
Mode	162	65	92
Standard Deviation	8.39	11.48	7.34
Minimum	142	52	80
Maximum	176	110	116

Tableno.2 shown that mean waist circumference was 96.69±7.34 cm.

Table3: Descriptive statistics of SBP,DBP, FBS Total Cholesterol, HDL, Triglycerides

Parameter	SBP	DBP	FBS	TC	HDL	TGL
Mean	137.93	88.31	155.16	190.18	43.81	197.55
Median	136	88	144	190	44	154
Mode	140	90	122	198	48	82
Std. Deviation	12.99	6.76	45.81	34.31	6.14	110.15
Minimum	116	78	101	132	32	77
Maximum	180	110	286	300	58	453

Table no.3 shown that the mean systolic and diastolic blood pressures were 137.93 mmHg and 88.31 mmHg, respectively, indicating hypertension among the study participants. The mean fasting blood sugar was 155.16 mg/dL, suggesting poor glycaemic control. Mean total cholesterol was 190.18 mg/dL, while mean HDL cholesterol was 43.81 mg/dL, indicating dyslipidaemia. Triglyceride levels were elevated with a mean value of 197.55 mg/dL and wide variability, reflecting a high prevalence of hypertriglyceridaemia.

Table 4: Thyroid Function Status(N=85)

Thyroid function status	Frequency	Percentage

Euthyroid	69	81.2
Hypothyroidism	3	3.5
Sub clinical hyperthyroidism	1	1.2
Sub clinical hypothyroidism	12	14.1
Total	85	100.0

Tableno.4 shown that Among 85 study subjects, 69(81.2%) were Euthyroid, 12(14.1%) have sub clinical hypothyroidism, 3(3.5%) were suffering from hypothyroidism and 2(1.2%) had sub clinical hyper thyroidism. 16(18.8%) were having thyroid dysfunction in our study.

Table5: Metabolic syndrome parameters among study subjects

No. of metabolic syndrome parameters	**Frequency**	**Percentage**
2criteria	13	15.4
3criteria	42	49.4
4criteria	15	17.6
5criteria	15	17.6
Total	85	100.0

Table no. 5 shown that Among 85 study subjects, 25(29.4%) fulfilled all metabolic syndrome criteria, 25(29.4%) fulfilled 4 out of 5metabolicsyndromecriteria, 32(37.6%) fulfilled3outof 5 metabolic syndrome criteria and 3(3.6%) fulfilled 2 criteria.

Table 6: Association between gender, age categories and thyroid function status

Category		**Euthyroid**	**Hypothyroid**	**Sub clinical hyperthyroid**	**Sub clinical hypothyroid**	**p-value**
Gender	Male	32(46.4%)	1(33.3%)	0	2(16.7%)	0.049*
	Female	37(53.6%)	2(66.7%)	1(100%)	10(83.3%)	
Age group	<40 Years	29(42%)	2(66.7%)	0	6(50%)	0.5
	41-50 Years	26(37.7%)	1(33.3%)	1(100%)	2(16.7%)	
	51-60 years	9(13%)	0	0	4(33.3%)	
	>61 years	5(7.2%)	0	0	0	

*Fischer'stest, p=0.049

Table no. 6 shown that Subclinical hypothyroidism was significantly more common in females 10(83.3%) than males (p=0.049). Subclinical hypothyroid patients were distributed across age groups(<40years:50%;41–50years:16.7%;51–60years:33.3%),but age was not significantly associated with thyroid dysfunction (p=0.5).

Table7:Association Between Thyroid Function and MetS Criteria

Metabolic syndrome criteria	**Euthyroid**	**hypothyroid**	**Sub clinical hyperthyroid**	**Sub clinical hypothyro**	**Pvalue**

				id	
2criteria	13(18.8%)	0	0	0	
3criteria	38(55.1%)	1(33.333%)	0	3(25%)	
4criteria	11(15.9%)	1(33.333%)	1(100%)	2(16.7%)	
5criteria	7(10.2%)	1(33.333%)	0	7(58.3%)	0.002*

*Fischer'stest, p=0.002

Table no.7 shown that all patients with subclinical hypothyroidism were having >3criteria in metabolicsyndrome.7(58.3%) of subjects with subclinical hypothyroidism were having 5 criteria of metabolic syndrome. This was statistically significant (P value-0.002). All the patients with hypothyroidism were having >3 criteria in metabolic syndrome

DISCUSSION

This study confirms a significant association between thyroid dysfunction, particularly subclinical hypothyroidism, and MetS, with a prevalence of 18.8% among 85 patients. This finding aligns with previous studies reporting thyroid dysfunction prevalence ranging from 16.7% to 54% in MetS patients. [19,20,22,26] Subclinical hypothyroidism was the most common thyroid abnormality (14.1%), consistent with reports by Abd-El-Hay et al. (21%) and Balakrishna et al. (25.3%). [25,27] The higher prevalence in females (83.3% of subclinical hypothyroid cases) corroborates studies by Rao et al. and Ginnaram et al., which noted a female predominance in thyroid dysfunction among MetS patients. [21,24] This may reflect sex-specific differences in thyroid autoimmunity or hormonal influences, although thyroid antibodies were not assessed in this study.

The significant association between subclinical hypothyroidism and the presence of three or more MetS criteria ($p = 0.002$) suggests that thyroid dysfunction exacerbates the cardiometabolic burden in MetS. This is supported by Jiaji He et al., who found increased waist circumference, triglycerides, and blood pressure in hypothyroid patients. [26] Thyroid hormones regulate lipid metabolism, and hypothyroidism reduces lipid degradation, leading to elevated triglycerides and LDL cholesterol, which are key components of MetS. [9,28] Furthermore, hypothyroidism impairs endothelial function and increases vascular resistance, contributing to hypertension, as noted by Taddei et al. [29] These mechanisms likely underlie the observed link between thyroid dysfunction and MetS severity.

The lack of significant correlations between T4/TSH and MetS parameters contrasts with the findings of Chakradhar et al., who reported associations with blood sugar and waist circumference. [19] This discrepancy may be attributed to the small sample size and high variability in our study, as well as the absence of data on confounding factors such as thyroid autoantibodies or adipokines (e.g., leptin, resistin). Hospital-based recruitment may have introduced selection bias, as patients with advanced MetS are more likely to seek tertiary care. Additionally, the cross-sectional design limits causal inferences, and the lack of ultrasound or iodine status assessments precludes a comprehensive evaluation of thyroid pathology.

Future studies should employ larger, population-based samples and include longitudinal follow-up to assess the progression of thyroid dysfunction and its impact on cardiovascular outcomes in MetS. Measuring thyroid autoantibodies, adipokines, and iodine status could provide deeper insights into the mechanisms linking thyroid dysfunction and MetS. Routine thyroid screening in MetS patients, particularly females, may facilitate early intervention to mitigate cardiovascular risk, as supported by Deshmukh et al. and Saluja et al. [20,23]

Limitations

The study was limited by a small sample size, which restricts generalizability, and its hospital-based design, which may introduce selection bias. Confounding factors such as thyroid autoantibodies, iodine status, and adipokines (e.g., leptin, resistin) were not assessed. Patients on levothyroxine could not be evaluated for prior thyroid status due to incomplete data.

Recommendations

Larger, multi-center studies with longitudinal follow-up are needed to confirm these findings and assess the progression of thyroid dysfunction in MetS. Including thyroid autoantibody testing and ultrasonography could clarify the etiology of thyroid dysfunction. Community-based studies in primary care settings would better represent India's diverse population.

CONCLUSION

Thyroid dysfunction, particularly subclinical hypothyroidism, is prevalent among MetS patients in Kurnool, Andhra Pradesh, and is associated with more severe MetS profiles, especially in females. Routine thyroid function testing in MetS patients could enable early intervention to reduce cardiovascular and metabolic risks. These findings advocate integrated screening and management strategies in India's growing MetS population.

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Conflict of interest: None declared.

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