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# Study of Thyroid Dysfunction in Patients with Metabolic Syndrome

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**Keywords:**
Metabolic syndrome, thyroid dysfunction, hypothyroidism, metabolic components

## Abstract
Background: Thyroid impairment is common in patients with metabolic syndrome. The study's goal was to learn more about the interplay between tests for thyroid function and other markers of metabolic syndrome. Subject matter and method: According to the NCEP- ATP III diagnostic criteria for metabolic syndrome, 61 individuals with the condition were included in the research and divided into three groups. Thyroid tests were performed and compared to criteria for metabolic syndrome. The results showed that out of a total of 61 patients diagnosed with MetS, 24 (39.3 percent) were men, while 37 (60.7 percent) were female, for a ratio of men to women of 1:1.5. The average age of participants was 53.69 14.78 years old. A majority of the patients belonged to the age group of ≥ 61 years. Of the 61 patients with MetS, 31 (50.8%) subjects had 3 components of MetS, 17 (27.9%) had 4 components of MetS and 13 (21.3%) had 5 components of MetS. The prevalence of metabolic syndrome in euthyroid, subclinical hypothyroid, hypothyroid, subclinical hyperthyroid and hyperthyroid patients was 67.2%, 9.8%, 13.1%, 6.6% and 3.3% respectively. The prevalence of thyroid dysfunction was 32.8%. Among 13 patients who had 5 components of MetS, only 5 (38.5%) patients were euthyroid and 8 (61.5%) had thyroid dysfunction. Conclusion: Overt hypothyroidism was the most frequent thyroid dysfunction observed in the present study. This study concludes that thyroid dysfunction increases as the number of metabolic syndrome components increases. Therefore, every patient with metabolic syndrome should be screened for thyroid function tests.

## 1. Introduction

Type 2 cardiovascular disease and diabetes (CVD) associated factors often occur together, a condition known as metabolic syndrome (MetS). The most commonly accepted criteria for diagnosing metabolic syndrome are those proposed by the International Diabetes Federation, or IDF, and the National Lipid Education Program's Adult Therapy Panel III (ATP III).[1],[2] These four key elements of MetS include different biological characteristics: Weight gain, especially around the middle as measured through the waist girth; blood sugar levels indicative of diabetes or an increased risk of developing the condition; abnormalities in lipids indicative of metabolic risk (such as raised triglycerides or low levels of good cholesterol; and elevated blood pressure). When at least three of the stated components are off, you have MetS.

In clinical practise, patients with both thyroid disease and MetS are common. Thyroid dysfunction is characterised by abnormal levels of thyroid-stimulating hormone (TSH) in conjunction with abnormalities in T3 and T4. Atherosclerotic heart disease is more likely to occur in those with both MetS and thyroid problems. Nonalcoholic fatty liver disease, also (NAFLD) and obesity have many of the same risk factors for developing cardiovascular disease, cerebrovascular disease, and atherosclerosis. Thyroid hormone's influence on lipid metabolism and arterial pressure may provide some insight into the connection between the two. Thyroid hormones are very influential, impacting practically every organ in

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the body. This hormone has been associated to metabolic syndrome and seems to serve as a general pacemaker, increasing metabolic rate.[3]

The goals of this research are to (1) evaluate thyroid function in individuals with metabolic syndrome and (2) determine whether or not metabolic syndrome components are correlated with thyroid dysfunction.

## 2. Material and Methods

*Aim*: "To study the thyroid function tests in patients with metabolic syndrome and to find its relation with the components of metabolic syndrome. *Objectives*: To study the clinical and laboratory parameters of metabolic syndrome, to study thyroid function tests in patients with metabolic syndrome and to study the relation between thyroid dysfunction and components of metabolic syndrome. *Study design*: prospective and observational study." *Study setting*: The present study is a single center, hospital-based study conducted at Krishna Hospital and Medical Research Center on patients admitted between October 2020 to October 2022. *Inclusion criteria*: The research included all participants over the age of 18 who satisfied the NCEP- ATP III criteria for the metabolic syndrome. (Table 1) Criteria for exclusion: a) People who have been diagnosed with either hypothyroidism, the condition, or subclinical manifestations of either condition. b) Patients receiving treatment for hypertension, type 2 diabetes, thyroid disease, or lipid problems. c) People on pills for contraception, lithium, a drug called or statins. Dialysis patients, patients with liver disease, CCF, and pregnant women. *Methodology:* Participants who met the study's requirements were enrolled. Each patient's height, weight, waist size, and blood pressure were recorded after obtaining their informed permission for these procedures. The supine reading was taken using a mercury-based sphygmomanometer (Diamond BP MR-120 Mercury BP Deluxe) that had been properly calibrated. The average of at least two measurements with a one-minute gap in between them was recorded. Samples of blood were drawn from a vein while the subjects were fasting and tested for glucose, fatty acids, HDL cholesterol, a substance known as thyroxine, and hormone that stimulates the thyroid. According to the amount of NCEP-ATP III criteria met, patients were divided into three groups. Thyroid problems were matched to these parts of MetS. *Statistical Analysis:* This data was collected and analyzed using SPSS 21.0 trial version. Age was expressed as the mean standard deviation. The 'p'< 0.05 was considered statistically significant. T-test was used to study the difference between continuous variables groups.

**Table 1:** Criteria for metabolic Syndrome as per NCEP-ATP III criteria

| At least three of the five | | |
|---|---|---|
| 1. | Glucose abnormalities as defined by | Fasting plasma glucose ≥ 100mg/dl |
| 2. | Central obesity as defined by | Waist circumference<br>• ≥ 102 cm (40 inches) in men,<br>• ≥ 88 cm (35 inches) in women |
| 3. | Dyslipidemia as defined by | Triglycerides ≥ 150 mg/dl |
| 4. | Dyslipidemia as defined by | HDL<br>• < 40 mg/dl (men),<br>• < 50 mg/dL (women) |
| 5. | Elevated blood pressure as defined by | BP ≥ 130/85 mmHg |

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## 3. Results

**Age and gender distribution of the study population**

There were 61 patients with MetS in this research; 24 (39.3%) were men, while 37 (60.7%) are female for a male-to-female ratio of 1:1.5. The average age of participants was 53.69 14.78 years old. Patients younger than 61 made up the largest demographic (31.1%), followed by those between the ages of 50 and 60 (26.2%). Participants' ages ranged from 23 to 85 years old throughout the research. (Table 2)

**Metabolic Syndrome (MetS)**

Of the 61 patients with MetS, 31 (50.8%) subjects had 3 components of MetS, 17 (27.9%) had 4 components of MetS and 13 (21.3%) had 5 components of MetS. Amongst the patients with 3 components, the mean age was 48.26 (± 14.45), and "the minimum and maximum age were 23 and 74 respectively Amongst the patients with 4 components, the mean age was 60.47 (± 15.59), the minimum and maximum age were 40 and 85 respectively. Amongst the patients with 5 components, the mean age was 53.69 (± 9.30), and the minimum and maximum ages were 45 and 72 respectively." (Table 3)

As the mean age of the study population increased, the number of components of MetS also increased. This difference between mean age and components of MetS is statistically significant. (One-way Annova test, 'p' value = 0.010). (Table 3)

The total number of components of the metabolic syndrome rose with increases in the circumference of the abdomen, systolic as well as diastolic blood pressure, and fasting blood sugar levels. (p-values are 0.001, 0.001, which is 0.002, and 0.001 for each (Table 4)

**Table 2:** Frequency distribution of age and gender of the study population with metabolic syndrome

| Frequency distribution of age (Years) | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | n=24 | % | n=37 | % | n=61 | % |
| ≤ 30 | 1 | 20 | 4 | 80 | 5 | 8.2 |
| 31-40 | 3 | 37.5 | 5 | 62.5 | 8 | 13.1 |
| 41-50 | 5 | 38.5 | 8 | 61.5 | 13 | 21.3 |
| 51-60 | 7 | 43.8 | 9 | 56.3 | 16 | 26.2 |
| ≥ 61 | 8 | 42.1 | 11 | 57.9 | 19 | 31.1 |
| Total | 24 | 39.3 | 37 | 60.7 | 61 | 100 |

**Table 3:** Distribution of metabolic syndrome in the study population

| Metabolic syndrome components | n = 61 | percentage |
|---|---|---|
| Three | 31 | 50.8 |
| Four | 17 | 27.9 |
| Five | 13 | 21.3 |
| Total | 61 | 100 |

| Age (years) | Metabolic syndrome components | | |
|---|---|---|---|
| | Three | Four | Five |
| Mean (± SD) | 48.26 (± 14.45) | 60.47 (± 15.59) | 53.69 (± 9.30) |
| Minimum | 23 | 40 | 45 |
| Maximum | 74 | 85 | 72 |

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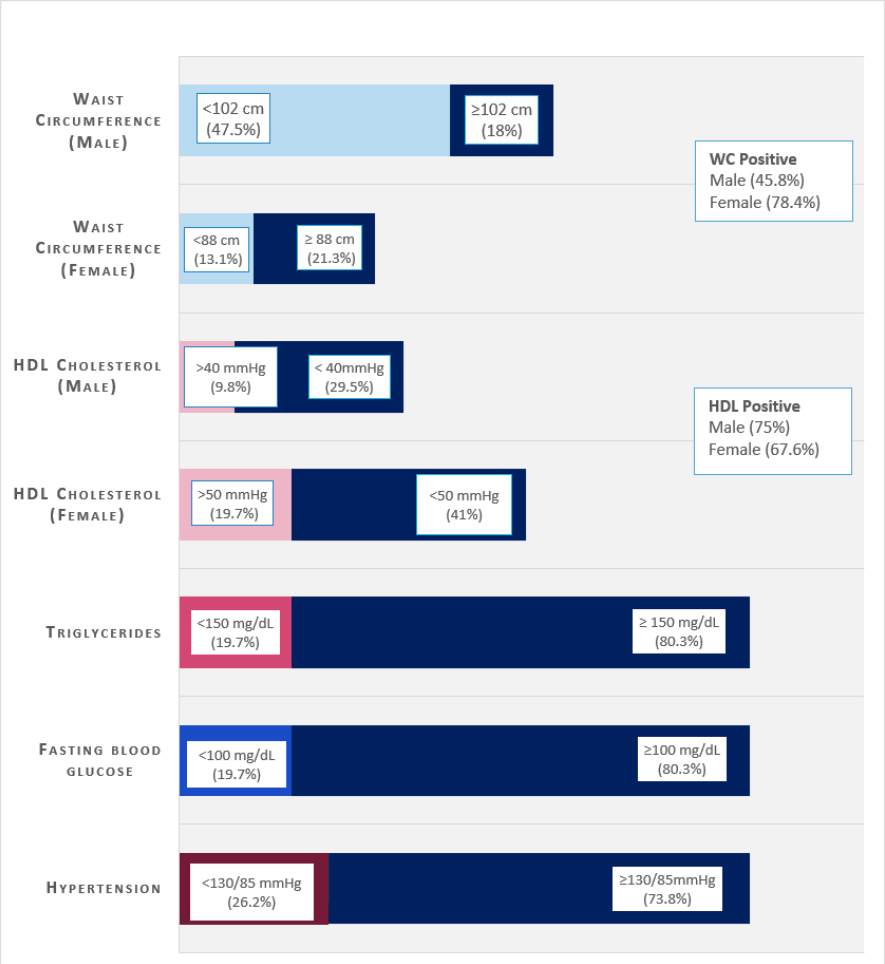
**Table 4:** Mean and standard deviation of metabolic parameters

| Metabolic parameters (Mean ± SD) | Metabolic syndrome components | | | One-way Annova test P value |
|---|---|---|---|---|
| | Three | Four | Five | |
| BMI (kg/m$^2$) | 26.30 (± 7.96) | 28.25 (± 7.25) | 32.31 (± 7.44) | 0.68 |
| Waist circumference (cm) | 89.81 (± 6.10) | 99.76 (± 7.55) | 104.85 (± 10.01) | <0.001 |
| HDL (mg/dL) | 44.26 (± 12.93) | 41.18 (± 8.01) | 35.31 (± 6.31) | 0.45 |
| Triglycerides (mg/dL) | 203.97 (± 75.78) | 197.65 (± 96.32) | 205 (± 38.80) | 0.54 |
| FBS (mg/dL) | 114.65 (± 25.83) | 131.88 (± 55.53) | 177.85 (± 49.20) | <0.001 |
| SBP (mmHg) | 125.48 (± 19.29) | 130.94 (± 15.25) | 147.69 (± 18.78) | 0.002 |
| DBP (mmHg) | 75.81 (± 9.58) | 74.41 (± 9.66) | 59.23 (± 7.60) | <0.001 |

**Figure 1:** Distribution of the components of metabolic syndrome in the study population



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**Thyroid dysfunction**

"Based on their thyroid function tests, the patients were divided into 5 groups, Euthyroid, Subclinical hypothyroidism, Hypothyroidism, Subclinical Hyperthyroidism and Hyperthyroidism. The prevalence of euthyroidism in the study population was 67.2%, and the prevalence of thyroid dysfunction was 32.8%, with hypothyroidism (13.1%) having the highest prevalence, followed by subclinical hypothyroidism (9.8%). Subclinical hyperthyroidism and overt hyperthyroidism were found in 6.6% and 3.3% of the subjects, respectively" (Table 5)

**Table 5:** Distribution of thyroid function test profile in the study population

| TFT profile | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | n=24 | % | n=37 | % | n=61 | % |
| Euthyroid | 17 | 41.5 | 24 | 58.8 | 41 | 67.2 |
| Subclinical Hypothyroidism | 2 | 33.3 | 4 | 66.7 | 6 | 9.8 |
| Hypothyroidism | 2 | 25 | 6 | 75 | 8 | 13.1 |
| Subclinical Hyperthyroidism | 3 | 75 | 1 | 25 | 4 | 6.6 |
| Hyperthyroidism | 0 | 0 | 2 | 5.4 | 2 | 3.3 |
| Total | 24 | 39.3 | 37 | 60.7 | 61 | 100 |

**Metabolic syndrome and thyroid dysfunction**

The prevalence of metabolic syndrome in euthyroid, subclinical hypothyroid, hypothyroid, subclinical hyperthyroid and hyperthyroid patients was 67.2%, 9.8%, 13.1%, 6.6% and 3.3% respectively. The relation between the thyroid status and components of metabolic syndrome in this study population is statistically significant ($X^2$ = 16.267; DF =8; 'p' value = 0.039) (Table 6), (Figure 2)

Among 13 patients who had 5 components of MetS, only 5 (38.5%) patients were euthyroid and 8 (61.5%) had thyroid dysfunction. Among 31 patients who had 3 components of MetS, a majority of 25 (80.6%) patients were euthyroid and only 6 (19.4%) patients had thyroid dysfunction. The prevalence of thyroid dysfunction in MetS was 32.8%. As the components of MetS increased the thyroid dysfunction also increased. This relation between thyroid dysfunction and components of metabolic syndrome in this study population is statistically significant ($X^2$ = 7.463; DF =2; 'p' value = 0.024) (Table 7), (Figure 3)

"Serum TSH had a positive correlation with waist circumference ('r' = 0.456, 'p'<0.001), body mass index ('r' =0.364, 'p'=0.004), (diastolic blood pressure ('r' =0.127, 'p'=0.127), and fasting blood sugar ('r' =0.347, 'p'=0.006). Serum TSH had a negative correlation with systolic blood pressure ('r' = -0.047, 'p'=0.721), serum triglycerides ('r' = -0.116, 'p'=0.200) and HDL ('r' = -0.109, 'p'=0.403)". (Figure 4)

Table 6: Relation between thyroid profile and components of metabolic syndrome

| Thyroid status | Metabolic syndrome components | | | | | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Three | | Four | | Five | | | |
| | n=31 | % | n=17 | % | n=13 | % | n=61 | % |
| Euthyroid | 25 | 61 | 11 | 26.8 | 5 | 12.2 | 41 | 67.2 |
| Subclinical Hypothyroidism | 1 | 16.7 | 3 | 50 | 2 | 33.3 | 6 | 9.8 |
| Hypothyroidism | 2 | 25 | 1 | 12.5 | 5 | 62.5 | 8 | 13.1 |
| Subclinical Hyperthyroidism | 2 | 50 | 2 | 50 | 0 | 0 | 4 | 6.6 |
| Hyperthyroidism | 1 | 50 | 0 | 0 | 1 | 50 | 2 | 3.3 |
| Total | 31 | 50.8 | 17 | 27.9 | 13 | 21.3 | 61 | 100 |

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**Figure 2:** Prevalence of Metabolic syndrome in different thyroid conditions

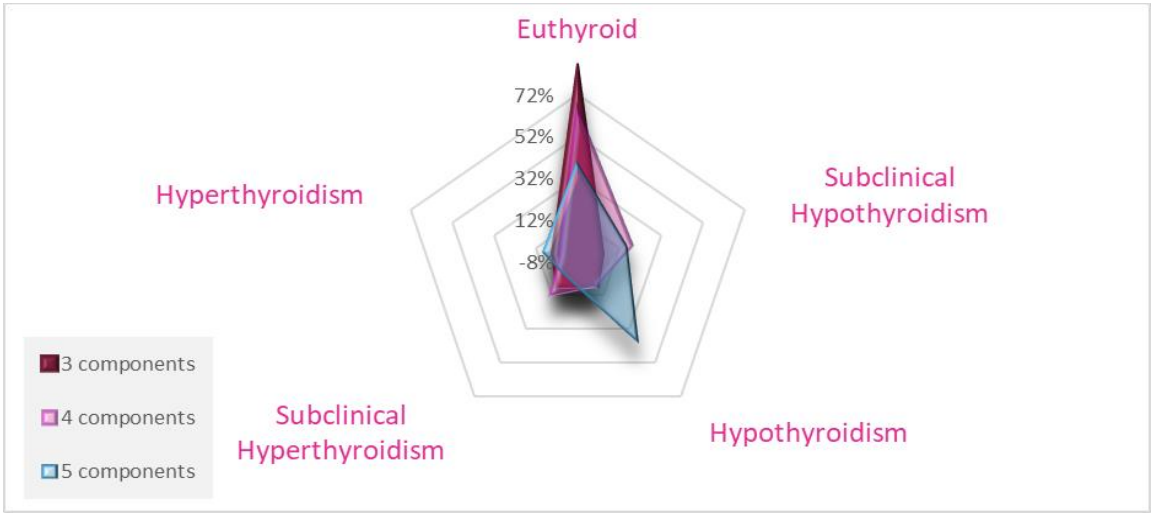


**Table 7:** Relation between metabolic syndrome and thyroid dysfunction

| Metabolic syndrome components | Thyroid status | | | | Total | |
|---|---|---|---|---|---|---|
| | Euthyroid | | Thyroid dysfunction | | | |
| | n=41 | % | n=20 | % | n=61 | % |
| Three | 25 | 80.6 | 6 | 19.4 | 31 | 50.8 |
| Four | 11 | 64.7 | 6 | 35.3 | 17 | 27.9 |
| Five | 5 | 38.5 | 8 | 61.5 | 13 | 21.3 |
| Total | 41 | 67.2 | 20 | 32.8 | 61 | 100 |

**Figure 3:** Relation between metabolic syndrome and thyroid dysfunction

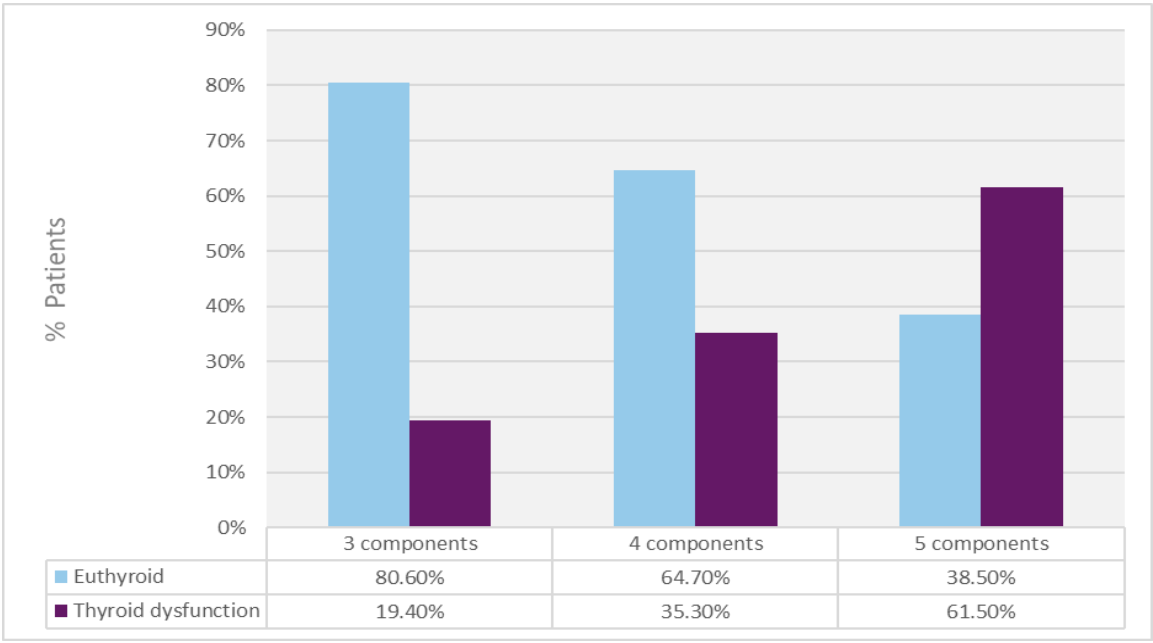

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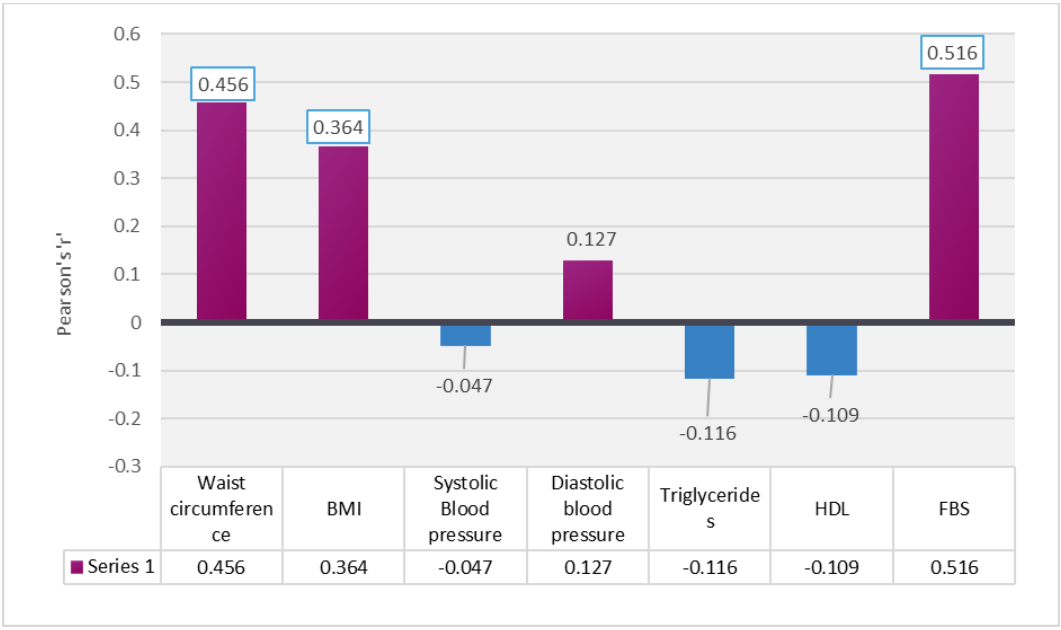
**Figure 4:** Correlation between various parameters and serum TSH




## 4. Discussion

"The mean age of the study population was 53.69 ± 14.78 years. According to the study conducted by Khatiwada *et al*, Gupta *et al*, and Deshmukh *et al*, the mean age of the patients with metabolic syndrome was 47 ± 12.5, 51.55 ± 10.73 and 47.9 ± 10.96 respectively, which was very similar to our study.[7],[8],[4] This study was predominated by the female gender, with a male to female ratio of 1:1.5. Similar female predominance was shown by the study conducted by *Gyawali P et al*, *Gupta et al* and Shantha *et al* but the study conducted by Deshmukh *et al* showed a female predominance of 75%.[6],[8],[9],[4] This was in complete contrast to the study conducted by He *et al* and Khatiwada *et al* who showed male predominance".[5],[7] (Table 9)

The prevalence of euthyroidism in the study population was 67.2%, and the prevalence of thyroid dysfunction was 32.8%, with hypothyroidism (13.1%) having the highest prevalence, followed by subclinical hypothyroidism (9.8%). "Subclinical hyperthyroidism and overt hyperthyroidism were found in 6.6% and 3.3% of the subjects, respectively. This was similar to the study conducted by Deshmukh *et al* where the prevalence of thyroid dysfunction was 28% and hypothyroidism was the majority (17.6%)".[4] The studies conducted by He *et al*, Gyawali P *et al*, Khatiwada et a,l Gupta *et al*, Shantha *et al* and Dr E. Prabhu *et al* had subclinical hypothyroidism as the most common prevalence of thyroid dysfunction which was 13.67%, 29.32%, 26.6%, 18.5 %, 21.9% and 15% respectively.[5],[6],[7],[8],[9],[10] The prevalence of thyroid dysfunction is 15.45% among the Chinese population as per the study conducted by He *et al* and the Nepalese population had a prevalence of 31.9% according to the study conducted by Khatiwada *et al*.[5],[7]

In the present study, "thyroid dysfunction was more common among females (35.1%) than males (29.2%) but was not statistically significant (p' value = 0.628). This was similar to the study conducted by Khatiwada *et al* where the prevalence of thyroid dysfunction was 26% and 39.7% in males and females respectively".[7] But the study conducted by Gupta *et al* had 38% male prevalence and 32.8% female prevalence this was opposite to our study. [8] (Table 8)

A total of 31 (50.8%) subjects had 3 components of MetS of which, 25 (80.6%) were euthyroid and 6 (19.4%) had thyroid dysfunction. A total of 17 (27.9%) subjects had 4 components of MetS of which, 11 (64.7%) were euthyroid and 6 (35.3%) had thyroid dysfunction. A total of 13 (21.3%) subjects had 5 components of MetS of which, 5 (38.5%) were euthyroid and 8 (61.5%) had thyroid dysfunction. As

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the number of components of MetS increased, thyroid dysfunction also increased. This relation between thyroid dysfunction and metabolic syndrome is significant ('p' value = 0.024).

This is similar to the study conducted by Dr E. Prabhu *et al* among 60 subjects with MetS, a total of 28 (46.60%) subjects had 3 components of MetS of which, 25 (89.3%) were euthyroid and 3 (10.7%) had thyroid dysfunction. Total 20 (33.3%) subjects had 4 components of MetS of which, 17 (85%) were euthyroid and 3 (15%) had thyroid dysfunction. A total of 12 (20%) subjects had 5 components of MetS of which, 7 (58.3%) were euthyroid and 5 (41.7%) had thyroid dysfunction. ('p' value = 0.060). [10] (Table 9)

**Table 8:** Comparison between various studies and the present study

| | | Present study | Gupta *et al*[8] | Dr E. Prabhu *et al*[10] |
|---|---|---|---|---|
| n | | 61 | 200 | 60 |
| Type of study | | Cross sectional study | Cross sectional study | Cross sectional study |
| Male: Female (%) | | 39.3%:60.7% | 41%:59% | 45%:55% |
| Mean age group | | 53.69 ± 14.78 | 51.55 ± 10.73 | - |
| Common age group (years) | | ≥ 61 | 45-55 | 36- 55 |
| MetS | 3 components | 50.8 % | 63.5 % | 46.67 % |
| | 4 components | 27.9 % | 32.5 % | 33.33 % |
| | 5 components | 21.3 % | 4 % | 20 % |
| occurrence of dysfunction of thyroid in MetS | | 32.8% | 25% | 17.77% |
| occurrence of euthyroidism | | 67.2% | 75% | 83.33% |
| occurrence of subclinical hypothyroidism | | 9.8% | 18.5 % | 15% |
| occurrence of hypothyroidism | | 13.1% | 8.5 % | 3.33% |
| occurrence of subclinical hyperthyroidism | | 6.6% | 1 % | 0% |
| occurrence of hyperthyroidism | | 3.3% | 0.5 % | 0% |

| MetS components | Present study | | | | Dr E. Prabhu *et al*[10] | | | |
|---|---|---|---|---|---|---|---|---|
| | Euthyroid | | Thyroid dysfunction | | Euthyroid | | Thyroid dysfunction | |
| | n | % | n | % | n | % | n | % |
| 3 | 25 | 80.6 | 6 | 19.4 | 25 | 89.3 | 3 | 10.7 |
| 4 | 11 | 64.7 | 6 | 35.3 | 17 | 85 | 3 | 15 |
| 5 | 5 | 38.5 | 8 | 61.5 | 7 | 58.3 | 5 | 41.7 |
| Total | 41 | 67.2 | 20 | 32.8 | 49 | 81.7 | 11 | 18.3 |
| | $X^2$ = 7.463; DF =2; 'p' value = 0.024 | | | | $X^2$ = 5.597; DF =2; 'p' value = 0.060 | | | |

**Table 9:** Comparison between various studies and the present study

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## 5. Conclusion

Females constituted a disproportionately large portion of the study group, and the prevalence of metabolic syndrome components three, four, and five were emphasised in this research. Tests for thyroid function were more often abnormal in persons with all five features of the metabolic syndrome. The most common kind of thyroid malfunction seen here was overt hypothyroidism. The results of this research indicate that the presence of more components of the metabolic disorder is associated with an increase in thyroid problems. Thyroid function testing should be part of the diagnostic process for all patients with metabolic syndrome.

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