Research Article

Relationship of thyroid profile with body mass index and metabolic syndrome

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ABSTRACT

Background: Metabolic syndrome is known to be associated with endocrine disorders, especially the thyroid dysfunction. The resultant thyroid dysfunction in patients with metabolic syndrome may add up to the already existing burden of cardiovascular diseases. **Objectives:** This study was intended to assess the thyroid function in patients with metabolic syndrome and evaluate its relationship with components of metabolic syndrome. **Materials and Methods:** A cross-sectional study was conducted among 100 adults attending the medicine department of a teaching hospital in Tamil Nadu. Relevant clinical examination with anthropometric measurements and blood examination was done in them. **Results:** There were 23 (23%) patients totally with at least three components of metabolic syndrome among the study population. The incidence of metabolic syndrome in adults with overt hypothyroidism was 100% and it was 50% in subclinical hypothyroidism. Almost all the components of metabolic syndrome except high-density lipoprotein cholesterol were significantly associated with thyroid dysfunction. Values of serum thyroid-stimulating hormone and free T4 correlated with waist circumference. There was a negative correlation of triglycerides with free T3 and T4 values. **Conclusion:** Thyroid dysfunction, especially the hypothyroidism, is commonly associated with metabolic syndrome. Therefore, there is a need to screen patients with metabolic syndrome for thyroid dysfunctions and vice versa.

KEY WORDS: Thyroid Dysfunction; Metabolic Syndrome; Subclinical Hypothyroidism

INTRODUCTION

The prevalence of overweight and obesity has been increasing significantly in recent decades. According to the World Health Organization, 21.5% and 4.6% are the crude estimates for the prevalence of overweight and obesity in the Southeast Asian regions.[1] According to the National Family Health Survey-4, the prevalence of overweight and obesity (body mass index ≥25) is 18.9 and 20.6 among Indian men and women, respectively.[2]

Thyroid hormones play an important role in regulating thermogenesis, and glucose and lipid metabolism, which make them a key factor regulating mammalian dynamic energy balance.[3] The low thyroid hormone concentration is associated with low-energy expenditure[4] and fluid retention[5] which may manifest as obesity. In India, hypothyroidism is considered to be the most common thyroid disorders affecting one in ten adults.[6]

Some studies have tried to attribute obesity to subclinical hypothyroidism.[7] In obese patients, other than increased levels of thyroid-stimulating hormone (TSH), there should also be an increase in free T3[8,9] and T4[8] concentrations. This fact is inconsistent with the thought that subclincial hypothyroidism causes obesity. Thus, the relationship between thyroid function and body weight needs to be studied more.

Metabolic syndrome constitutes a cluster of risk factors characterized by hypertension, atherogenic dyslipidemia, hyperglycemia, prothrombotic, and pro-inflammatory conditions.[10] Serum TSH has been thought to have an association

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with metabolic risk factors. However, some studies[11] found no significant differences in certain components of lipid profile among people with high and low TSH. This disparity implies that there is a clear lack of clarity with regard to whether TSH really regulates metabolism in people.

Thus, the purpose of this study was to find out whether there is a relationship that exists between the thyroid hormones, body mass index (BMI), and components of metabolic syndrome.

MATERIALS AND METHODS

A cross-sectional study was conducted among adult subjects in the Department of Medicine of a tertiary care teaching hospital in Tamil Nadu between September 2011 and September 2013. Every 100th patient was included in the study. Those with previously diagnosed thyroid disease or obvious goiter, previously diagnosed heart disease, diabetes, other endocrine disorders, pregnant women, smokers, and those on long-term medications were excluded from the study.

Details of the patients were obtained and relevant clinical and laboratory investigations were performed after obtaining an informed written consent and after explaining the objectives of the study. The Institutional Ethics Committee clearance was obtained before the start of the study. Data regarding demographic details, anthropometric measurements, relevant clinical examination findings, and laboratory investigation findings were recorded in a pro forma.

BMI was calculated as weight in kilograms divided by the square of the height in meters (kg/m^2) and thus patients were divided into four groups as underweight, normal weight, overweight, and obese as categorized by the National Heart, Lung, and Blood Institute.[12]

For all blood investigations, blood was collected from the antecubital vein in the left arm and the subject was on an overnight fasting for 8 h or more. Thyroid profile included measurement of total T3, total T4, and TSH levels. T3 values between 1.2 and 2.1 nmol/L and T4 values between 70 and 150 nmol/L were considered normal. TSH values between 0.4 and 4 mIU/L were considered as normal.

Metabolic syndrome was diagnosed based on modified Asian National Cholesterol Education Program-Adult Treatment Panel III criteria.[13] Three out of five parameters need to be present to diagnose the metabolic syndrome.

Statistics

The data were entered into Microsoft Office Excel 2007 and IBM SPSS Version 21 was used for analysis. ANOVA test was used to see if there was a statistically significant difference between the groups and Pearson's correlation was used to find if there was a correlation that existed between the two variables.

RESULTS

A total of 100 adults were studied and the maximum number (34%) of participants belonged to 41–60 years age group. About 9.52% of the males and 6.89% of the females were found to have an increased waist circumference. About 24% of the participants had increased systolic and diastolic blood pressures while isolated increase in diastolic blood pressure was found in 16% and isolated systolic blood pressure increase was seen in 1%. Overall, 41% of the study participants were found to be hypertensive. About 22% and 33% of them had an increased fasting blood glucose levels and increased serum triglycerides, respectively. About 44% of the participants had high-density lipoprotein (HDL) levels below the normal range, as shown in Table 1.

Table 2 shows that there were 23 (23%) of the participants who had at least three components of metabolic syndrome. All the patients (100%) with overt hypothyroidism, 50% of subclinical hypothyroid subjects, and 19.5% of the euthyroid subjects presented with at least three components of metabolic syndrome.

Table 3 shows the mean values of the components of metabolic syndrome studied in subjects who are euthyroid, subclinical hypothyroid, and overt hypothyroid. ANOVA was used to check whether there was a statistically significant difference

Table 1: Baseline characteristics of the study population

Characteristics	Males (42) *n* (%)	Females (58) *n* (%)
Age distribution (years)		
18–30	10 (23.80)	12 (20.68)
31–40	7 (16.66)	11 (18.96)
41–60	14 (33.33)	20 (34.48)
61–90	11 (26.19)	15 (25.86)
Waist circumference		
>102 in males >88 in females	4 (9.52)	4 (6.89)
Systolic blood pressure		
>130 mmHg	13 (30.95)	12 (20.68)
Diastolic blood pressure		
>85 mmHg	18 (42.85)	22 (37.93)
Fasting blood glucose		
≥110 mg/dl	7 (16.66)	15 (25.86)
Serum triglycerides		
≥150 mg/dl	13 (30.95)	20 (34.48)
Serum high-density lipoprotein		
<40 mg/dl in men <50 mg/dl in females	11 (26.19)	33 (56.89)
Serum thyroid-stimulating hormone (mIU/L)		
0.4–4	37 (88.09)	51 (87.93)
4.1–9.9	3 (7.14)	5 (8.62)
≥10	2 (4.76)	2 (3.44)

in the mean values of the components of metabolic syndrome among the different groups of thyroid profile. $P < 0.05$ in all the components except the HDL suggested that there was a statistically significant difference between the groups.

Pearson's correlation was done to check whether there was a relationship between the thyroid profile components and components of metabolic syndrome. It was seen that TSH had a positive correlation with waist circumference and a negative correlation with HDL cholesterol. Both FT3 and FT4 had a negative correlation with triglycerides. FT4 had a negative correlation with waist circumference, as shown in Table 4.

DISCUSSION

The study was intended to identify whether there existed a relationship between the levels of thyroid hormone and components of metabolic syndrome. There were totally 23 patients (23%) who presented with three out of five parameters of metabolic syndrome. Of these 23 patients, 5 (21.73%) of them either had a subclinical hypothyroidism or an overt hypothyroidism when compared to only 3 patients (3.89%) with hypothyroidism in whom metabolic syndrome was absent. A Chi-square test was done to see if there existed a relationship between hypothyroidism in metabolic syndrome and it was proved that there existed a statistically significant relationship with $P = 0.006$. Out of the five patients who presented with abnormal thyroid function among the patients with metabolic syndrome, 3 (13.04%) of them had subclinical hypothyroidism and 2 (8.69%) had overt hypothyroidism. It can be seen from Table 3 that there existed a relationship between thyroid dysfunction and components of metabolic syndrome, i.e., blood glucose and triglycerides. It can be seen from Table 4 that there exists a negative relationship between serum triglycerides and thyroid hormones, FT3 and FT4.

Gyawali *et al*.[14] conducted a study to find the pattern of thyroid dysfunction in patients with metabolic syndrome in Nepal. It was found that the overall prevalence of thyroid dysfunction in patients with metabolic syndrome was 31.84% which is slightly higher than our study which revealed only 21.73%. There was a higher prevalence (29.32%) of subclinical hypothyroidism in patients with metabolic syndrome in the study done by Gyawali *et al*. which is similar to our study though the proportion was lower (13.04%) in our study. Another study done by Warring *et al*.[15] revealed that each unit increase in TSH was associated with 3% increase in the odds of prevalent metabolic syndrome and subclinical hypothyroidism with a TSH >10 mIU/L was significantly associated with increased odds of prevalent metabolic syndrome. Even in the present study, increased TSH levels in the form of subclinical and overt hypothyroidism are associated with metabolic syndrome. Thyroid hormones are known to affect the metabolism of glucose and lipids and thus the patient with thyroid dysfunction will end up having an abnormal lipid and glucose levels which are components of the metabolic syndrome.[16]

Table 2: Different grades of thyroid dysfunction and metabolic syndrome

Grades of thyroid dysfunction	Metabolic syndrome patients *n* (%)
Euthyroid subjects	18 (19.56)
Subclinical hypothyroidism	3 (50)
Overt hypothyroidism	2 (100)
Total number of patients with thyroid dysfunction	23 (23)

Table 3: Components of metabolic syndrome in the study population

Parameters	Euthyroid subjects	Overt hypothyroidism	Subclinical hypothyroidism	*P*-value
Systolic blood pressure (mmHg)	126.52±13.37	123±4.24	145.33±11.84	0.0136*
Diastolic blood pressure (mmHg)	83.76±8.71	78±2.82	93.66±5.85	0.0111*
Waist circumference (cm)	79.15±11.38	92.5±0.70	89.16±6.21	0.0016*
Blood glucose (mg/dl)	97.15±13.75	104±29.69	120.5±29.62	0.0137*
Triglycerides (mg/dl)	158.33±54.98	288±15.55	200.83±69.71	<0.0001*
High-density lipoprotein cholesterol (mg/dl)	46.31±5.48	45.5±7.77	49.66±2.50	0.4574

**P*-value <0.05

Table 4: Correlation of components of metabolic syndrome with thyroid profile

Parameters	Thyroid-stimulating hormone		FT3		FT4	
	r-value	*P*-value	*r*-value	*P*-value	*r*-value	*P*-value
Systolic blood pressure (mmHg)	0.1211	0.2501	−0.1081	0.2848	−0.1245	0.2190
Diastolic blood pressure (mmHg)	0.1586	0.1310	−0.0333	0.7444	−0.0101	0.9213
Waist circumference (cm)	0.5858	<0.0001*	−0.1720	0.0870	−0.3245	0.0009*
Blood glucose (mg/dl)	0.0720	0.4952	−0.0892	0.3785	−0.0550	0.5867
Triglycerides (mg/dl)	0.0720	0.4952	−0.2469	0.0136*	−0.1981	0.0483*
High-density lipoprotein cholesterol (mg/dl)	−0.210	0.0436*	−0.0686	0.5014	0.0127	0.9002

**P*-value <0.05

A study in India by Shantha *et al*. found subclinical hypothyroidism in 21.9% and overt hypothyroidism in 7.4% metabolic syndrome patients.[10] Similarly, a study by Meher *et al*.[17] showed a high prevalence of subclinical hypothyroidism (22%) and overt hypothyroidism (4%) in the metabolic syndrome patients. Thus, it can be seen that there is a high proportion of subclinical hypothyroidism in patients with metabolic syndrome.

Metabolic syndrome is a mixture of risk factors for the development of cardiovascular diseases (CVDs). There are studies which have associated thyroid dysfunction and especially subclinical hypothyroidism with metabolic syndromes.[18,19] Thus, the detection of thyroid dysfunction in patients in metabolic syndrome and their treatment may help in reducing the already existent high incidence of CVDs.

Limitation

Since this is a cross-sectional study, causality cannot be proved. Factors such as alcohol, diet, and physical activity could have acted as confounding factors and these have not been taken into account. Only TSH values were considered for classifying the study population into different groups.

CONCLUSION

Higher prevalence of overt and subclinical hypothyroidism in metabolic syndrome as seen in our study may have a harmful effect on cardiovascular health. Hypothyroidism will lead to increased lipid levels and hypertension leading to increased risk for CVD. The effects due to metabolic syndrome and hypothyroidism may be compounded to increase the risk for CVD. Thus, assessing thyroid function in metabolic syndrome patients may help identify patients at high risk for CVD.

REFERENCES

1. Prevalence of overweight, Obesity Among Adults-estimates by WHO Region. Global Health OBSERVATORY Data Repository. South East Asia Region. Available from: http://www.apps.who.int/gho/data/view.main-searo.BMI30CREGv?lang=en. [Last accessed on 2012 Jan 13].
2. National Family Health Survey (NFHS-4). India Fact Sheet. Ministry of Health and Family Welfare. International Institute for Population Sciences 2015-2016. Available from: http://www.rchiips.org/nfhs/pdf/NFHS4/India.pdf. [Last accessed on 2012 Jan 13].
3. Danforth E Jr., Burger A. The role of thyroid hormones in the control of energy expenditure. Clin Endocrinol Metab 1984;13:581-95.
4. Al-Adsani H, Hoffer LJ, Silva JE. Resting energy expenditure is sensitive to small dose changes in patients on chronic thyroid hormone replacement. J Clin Endocrinol Metab 1997;82:1118-25.
5. Villabona C, Sahun M, Roca M, Mora J, Gómez N, Gómez JM, *et al*. Blood volumes and renal function in overt and subclinical primary hypothyroidism. Am J Med Sci 1999;318:277-80.
6. Bagcchi S. Hypothyroidism in India: More to be done. Lancet Diabetes Endocrinol 2014;2:778.
7. Jin HY. Prevalence of subclinical hypothyroidism in obese children or adolescents and association between thyroid hormone and the components of metabolic syndrome. J Paediatr Child Health 2018;54:975-80.
8. Kok P, Roelfsema F, Langendonk JG, Frölich M, Burggraaf J, Meinders AE, *et al*. High circulating thyrotropin levels in obese women are reduced after body weight loss induced by caloric restriction. J Clin Endocrinol Metab 2005;90:4659-63.
9. De Pergola G, Ciampolillo A, Paolotti S, Trerotoli P, Giorgino R. Free triiodothyronine and thyroid stimulating hormone are directly associated with waist circumference, independently of insulin resistance, metabolic parameters and blood pressure in overweight and obese women. Clin Endocrinol (Oxf) 2007;67:265-9.
10. Shantha GP, Kumar AA, Jeyachandran V, Rajamanickam D, Rajkumar K, Salim S, *et al*. Association between primary hypothyroidism and metabolic syndrome and the role of C reactive protein: A cross-sectional study from South India. Thyroid Res 2009;2:2.
11. Rahbar AR, Kalantarhormozi M, Izadi F, Arkia E, Rashidi M, Pourbehi F, *et al*. Relationship between body mass index, waist-to-hip ratio, and serum lipid concentrations and thyroid-stimulating hormone in the euthyroid adult population. Iran J Med Sci 2017;42:301-5.
12. Classification of Overweight and Obesity by BMI, Waist. Circumference, and Associated Disease Risks; 2012. Available from: https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmi_dis.htm. [Last accessed on 2012 Dec 17].
13. Misra A, Khurana L. The metabolic syndrome in South Asians: Epidemiology, determinants, and prevention. Metab Syndr Relat Disord 2009;7:497-514.
14. 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;39:66-73.
15. Waring AC, Rodondi N, Harrison S, Kanaya AM, Simonsick EM, Miljkovic I, *et al*. Thyroid function and prevalent and incident metabolic syndrome in older adults: The health, ageing and body composition study. Clin Endocrinol (Oxf) 2012;76:911-8.
16. Rizos CV, Elisaf MS, Liberopoulos EN. Effects of thyroid dysfunction on lipid profile. Open Cardiovasc Med J 2011;5:76-84.
17. Meher LK, Raveendranathan SK, Kota SK, Sarangi J, Jali SN. Prevalence of hypothyroidism in patients with metabolic syndrome. Thyroid Res Pract 2013;10:60-4.
18. Ruhla S, Weickert MO, Arafat AM, Osterhoff M, Isken F, Spranger J, *et al*. A high normal TSH is associated with the metabolic syndrome. Clin Endocrinol (Oxf) 2010;72:696-701.
19. Park HT, Cho GJ, Ahn KH, Shin JH, Hong SC, Kim T, *et al*. Thyroid stimulating hormone is associated with metabolic syndrome in euthyroid postmenopausal women. Maturitas 2009;62:301-5.

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