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Original Research Article

A comparative cross sectional study on relationship between thyroid profile and anthropometric measurements

Raghavendra Bhat, Prakash Rao Katta Subraya*, Ramachandra Bhat C.

Department of Medicine, KVG Medical College, Sullia, Karnataka, India

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***Correspondence:**
Dr. Prakash Rao Katta Subraya,
E-mail: ksprkrao0@gmail.com

ABSTRACT

Background: The prevalence of obesity is increasing globally and one of the important factors associated with obesity is thought to be thyroid dysfunction. The objective of the present study was to find the incidence of subclinical hypothyroidism in overweight and obese individuals and to assess the relationship between the TSH levels and anthropometric parameters.
Methods: A cross sectional study was conducted among 100 adults attending the hospital selected by a systematic random sampling method. Standard protocols were used to assess the laboratory and anthropometric parameters. Written informed consent was taken from the subjects and institutional ethical clearance was obtained before starting the study.
Results: Of the 42% males and 58% females who were studied, 24% of the subjects had a BMI more than 24.99. 6% and 2% of the study subjects were having subclinical hypothyroidism and hypothyroidism respectively. There was a significant association between hypothyroidism and increased BMI values, waist circumference and waist hip ratio.
Conclusions: A highly significant association was found between the serum TSH levels and the Body Mass Index, Waist circumference and Waist Hip ratio. The mean TSH levels were higher in the obese when compared to normal subjects.

Keywords: Body Mass Index, Obesity, Thyroid Stimulating Hormone, Waist Circumference, Waist Hip Ratio

INTRODUCTION

The thyroid gland produces thyroid hormones which regulate basal metabolism, thermogenesis and play an important role in lipid and glucose metabolism, food intake and fat oxidation.[1] Thus it affects the overall rate of functioning of several organ systems in the body.

Thyroid diseases are amongst the commonest endocrine disorders worldwide. It is estimated that around 42 million people in India suffer from thyroid diseases.[2] The prevalence and pattern of thyroid disorders depends on sex, age, ethnic and geographical factors. Hypothyroidism, specifically, is the most common of thyroid disorders in India, affecting one in ten adults.[2] Overt thyroid disease is associated with marked changes in energy expenditure and body weight, with enhanced protein breakdown, lipolysis and typically weight loss in hyperthyroidism, and the reverse in hypothyroidism.[3-5]

Anthropometric measurements are a series of quantitative measurements used to assess the body composition of muscle, bone and adipose tissue. The common anthropometric measurements are the weight, height, Body Mass Index (BMI), Skin fold Thickness, Waist circumference and Hip circumference. These measurements are important because they represent diagnostic criteria for obesity.

Body composition and thyroid hormones appear to be closely related. Body weight is dependent on various factors. These include genetic makeup of the individual and environmental inputs like food intake and physical activity. Body weight and more commonly, obesity and hypothyroidism are two common clinical conditions that have been linked together closely. Novel view indicates that changes in thyroid-stimulating hormone (TSH) could well be secondary to obesity.[6]

The fact that thyroid dysfunction predisposes to weight problems is well known. Not surprisingly, studies done to date have indeed revealed significant association between thyroid function and obesity.[7] While some studies have based their findings on BMI alone as a measure of obesity, others have utilized waist circumference, waist hip ratio and waist to height ratio as parameters for comparison and assessment.[8] The present study aims to assess the incidence of subclinical hypothyroidism in the study subjects and people who are overweight and obsese. The study also aims at finding, if there is any association between thyroid function, as defined by TSH (thyroid stimulating hormone) level and obesity as defined by the body mass index (BMI), the waist circumference and the waist hip ratio.

METHODS

A cross sectional study was conducted among 100 adults whose age was more than 18 years and presenting to OPD (Outpatient Department) of Medicine Department of a tertiary care teaching hospital in Coimbatore, Tamil Nadu, India between September 2011 to September 2013. Study population was selected by systematic random sampling method wherein every 100th patient was included in the study.

Inclusion criteria

All patients who got selected by systematic random sampling method and were willing to participate in the study were included.

Exclusion criteria

Patients with previously diagnosed thyroid disease or obvious goitre, previously diagnosed heart disease, diabetes, other endocrine disorders, pregnant women, smokers and those on long term medications were excluded from the study.

An informed written consent was obtained from them after explaining the objectives of the study and the investigations that would be performed on them. 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 performa.

Height and weight were measured when the subjects were standing erect with arms by the side and wore light clothing and no slippers / shoes. Height was recorded in centimeters; Weight in kilograms. According to the NHLBI, BMI is calculated as weight in kilograms divided by the square of the height in meters (kg/m2) and is categorized into four groups as underweight, normal weight, overweight and obese.[9]

The WHO STEPS protocol was used to measure waist circumference and waist to hip ratio.[10] For the purpose of this study, the WHO expert consultation recommendations were used to quantify WC and WHR. Waist circumference less than 90cms in men and less than 80 cms in women were considered to be normal. The cut off for waist to hip ratio was 0.90 and 0.80 in men and women respectively.

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 hours or more. Thyroid profile included measurement of total T3, total T4, and Thyroid stimulating hormone (TSH) levels. T3 values between 1.2 and 2.1 nmol/L and T4 values between 70 to 150 nmol/L was considered normal. TSH values between 0.4 and 4 mIU/L was considered as normal.

The data was entered in Microsoft Office Excel 2007 and IBM SPSS Version 21 was used for analysis.

RESULTS

The present study involved 100 adult patients selected by systematic random sampling who presented to the outpatient clinic and medical wards of Coimbatore Medical College Hospital between September 2011 and September 2013. Of the 100 subjects, 42% were males and 58% were females. Mean age of males was 47.31 years and that of females was 47.59 years. The mean age of the whole sample was 47.47 years. The youngest patient in the present study was 18 years old; the oldest was 85 years old.

Among 76% of the males and 67% of the females had a normal BMI, whereas 11.9% of the males and 20.6% of the females belonged to overweight category. 9.5% of the males and 5.1% of the females were obese. 88% of the males and 87.9% of the females had normal TSH levels. 11.9% of the males and 12.06% females had increased TSH levels. Almost a quarter of the study population had an increased waist circumference (23.8% in males and 24.13% in females). 23.8% of the males and 18.9% of females had an increased waist hip ratio as seen in (Table 1).

The mean values of anthropometric measurements and thyroid profile with the minimum and maximum range are tabulated in (Table 2). (Table 3) shows the frequencies of the population in different categories of anthropometric measurements and different TSH levels.

Table 1: Baseline characteristics of the study population.

Sr. No.	Characteristics	Males No.(%)	Females No. (%)
I	Age distribution		
1	18-30 YEARS	10(23.80%)	12(20.68%)
2	31-40 Years	7(16.66%)	11(18.96%)
3	41-60 Years	14(33.33%)	20(34.48%)
4	61-90 Years	11(26.19%)	15(25.86%)
II	BMI		
1	<18.5	1(2.38%)	4(6.89%)
2	18.5-24.99	32(76.19%)	39(67.24%)
3	25-29.99	5(11.90%)	12(20.68%)
4	≥30	4(9.52%)	3(5.17%)
III	Waist circumference		
1	<90 In males <80 In females	32(76.19%)	44(75.86%)
2	> 90 In males > 80 In females	10(23.80%)	14(24.13%)
IV	Waist hip ratio		
1	< 0.90 In males < 0.80 In Females	32(76.19%)	47(81.03%)
2	> 0.90 In males > 0.80 In Females	10(23.80%)	11(18.96%)
V	Serum TSH		
1	0.4 – 4 mIU/L	37(88.09%)	51(87.93%)
2	4.1 – 9.9 mIU/L	3(7.14%)	5(8.62%)
2	≥10 mIU/L	2(4.76%)	2(3.44%)

A chi square test was done to assess if there was a relationship between BMI and TSH levels. It was seen that higher the BMI, higher the waist circumference and higher the waist hip ratio, there was more chance for the patient to have increased TSH levels (p <0.0001).

The mean values of TSH in each category of anthropometric measurement is tabulated in Table 4 and it can be seen that higher the BMI, higher the Waist circumference and higher the waist hip ratio, there was more chance for the patient to have higher TSH levels (p value <0.0001).

Table 5 and Figure 1 show that there is a significant positive relationship between anthropometric measurements and TSH levels.

Table 2: Mean values of thyroid profile and antrhopometric parameters.

Variable	Mean value	Minimum value	Maximum value
Weight	63.57±10.79	45.3	97.7
Height	165.07±8.76	149	186
BMI	23.09±3.41	17.8	33.4
Waist circumference	80.02±11.40	60	112
HIP circumference	99.44±4.68	85	109
Waist hip ratio	0.80±0.09	0.63	1.07
Serum T3 levels	1.56±0.33	0.1	2.21
Serum T4 levels	111.34±29.76	15	166
Serum TSH	3.01±3.21	0.5	28.9

Table 3: TSH values stratified against gender and anthropometric parameters.

Sr. No.	Characteristics	TSH Values						p value
		0.4-4 mIU/L		4.1-9.9 mIU/L		≥10mIU/L		
		Male	Female	Male	Female	Male	Female	
I	BMI							
1	<18.5	0	4	0	0	0	0	<0.0001*
2	18.5-24.99	33	39	0	0	0	0	
3	25-29.99	4	7	1	5	0	0	
4	≥30	4	1	0	0	0	2	
II	Waist circumference							
1	<90 In Males <80 In Females	32	44	0	0	0	0	<0.0001*
2	>90 In Males >80 In Females	9	7	1	5	0	2	
III	Waist hip ratio							
1	<0.90 In Males <0.80 In Females	32	47	0	0	0	0	<0.0001*
2	>0.90 In Males >0.80 In Females	9	4	1	5	0	2	

Table 4: Relationship of TSH values with anthropometric parameters

S No.	Anthropometric parameters	Category	Mean TSH value	Statistical test	p value
I	BMI			ANOVA/F Value	
1	< 18.5	Undernourished	0.925±0.29	16.5411	<0.0001*
2	18.5-24.99	Normal	2.125±0.72		
3	25-29.99	Overweight	5.08±2.42		
4	≥ 30	Obese	8.34±9.53		
II	Waist circumference			T Test/T Value	
1	< 90 In Males < 80 In Females	Normal(76)	2.08±0.78	6.0559	<0.0001*
2	> 90 IN Males > 80 IN Females	Abnormal (24)	6.06±5.62		
III	WAIST HIP RATIO			T test/T value	
1	< 0.90 In Males < 0.80 In Females	Normal (79)	2.13±0.83	6.2082	<0.0001*
2	> 0.90 IN Males > 0.80 IN Females	Abnormal (21)	6.30±5.83		

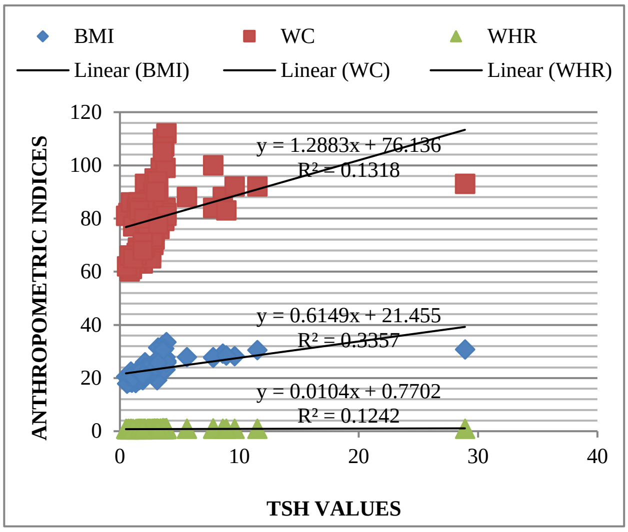

Figure 1: Correlation between TSH values and anthropometric parameters.

Table 5: Correlation between anthropometric parameters and TSH values.

Variable	R value	p value
TSH VS BMI	0.579	<0.0001*
TSH VS Waist Circumference	0.363	0.0002*
TSH VS Waist Hip Ratio	0.352	0.0003*

Tukey HSD Post-hoc Test for mean TSH levels in different categories of BMI.

- Group 1 vs Group 2: Diff=1.2000, 95%CI=-2.0085 to 4.4085, p=0.7623
- Group 1 vs Group 3: Diff=4.1550, 95%CI=0.6272 to 7.6828, p=0.0142
- Group 1 vs Group 4: Diff=7.4150, 95%CI=3.3547 to 11.4753, p=0.0000
- Group 2 vs Group 3: Diff=2.9550, 95%CI=1.0826 to 4.8274, p=0.0005
- Group 2 vs Group 4: Diff=6.2150, 95%CI=3.4679 to 8.9621, p=0.0000
- Group 3 vs Group 4: Diff=3.2600, 95%CI=0.1459 to 6.3741, p=0.0365

DISCUSSION

A cross sectional study was done among adults attending the hospital to look for any relationship between anthropometric parameters and thyroid profile. For this study, TSH was the only parameter utilised for classification into normal and abnormal thyroid states. Body Mass Index, Waist circumference and Waist Hip circumference were the parameters that were studied under anthropometric parameters.

In the present study, males and females accounted for 42% and 58% of the study population respectively. Among them, 76% of the males and 67% of the females were normal with respect to BMI. 12% of the males and 21% of the females were in the overweight category and 10% of the males and 5% of the females were obese which reflects the fact that 22% of the males and 27% of the females had a BMI of more than 25kg/m^2. This is comparable to NFHS 4 data of Karnataka where it was shown that 22.1% of the male population and 23.3% of the female population had a BMI of over 25kg/m^2.[11]

The prevalence of subclinical hypothyroidism was 6% in the present study. The frequency of subclinical hypothyroidism was more in the age group more than 60 years (66.66%) and lowest in the age group below 30 years (33.33%). This is comparable to a study done by Unnikrishnan A G et al, where the prevalence of subclinical hypothyroidism in Chennai, Tamil Nadu was 5.35% with higher frequency in the age group above 55 years and more commonly in females. Maximum number of cases of subclinical hypothyroidism in the present study was also found in females (83.33%) than males (16.66%). [12]

The prevalence of hypothyroidism was 2%. One of the female was 32 years and the other was 65 years old. Both the cases of hypothyroidism was seen in females whose BMI was more than 30 and had an increased waist hip ratio. This is in contrast to the study done by Unnikrishnan et al, where the prevalence of hypothyroidism was 10.95%.[12]

The present study showed that the study population with higher TSH values were in the overweight and obese categories as seen in Table 3. The mean TSH values were also much higher in people with increased BMI, Waist circumference and Waist hip ratio and this was statistically significant as seen in Table 4. These results correlate with studies done by Al Musa H M, Solanki A. There is clinical evidence suggesting that even mild thyroid dysfunction in the form of subclinical hypothyroidism is linked to significant changes in body weight and represents a risk factor for overweight and obesity.[13-15]

Study done by Namburi R P et al, in children and adolescents revealed that obesity is associated with elevated TSH levels, but there was no significant association between Serum TSH and severity of obesity. They concluded that elevation of TSH levels in obesity seems to be a consequence of obesity rather than a cause of obesity.[16]

The cause for the alteration in thyroid functions in obese individuals are not clearly known. One of the theory behind this alteration is the increased deiodinase activity leading to a high conversion rate of T4 to T3.

This is actually thought to be a defense mechanism in obese individuals where they are capable of counteracting the accumulation of fat by increasing energy expenditure.[17] Another proposed theory is that there is a compensatory increase in TSH levels and FT3 levels. This is an attempt to overcome the decreased tissue responsiveness to thyroid hormones due to decreased expression in adipocytes of obese individuals.[18] High levels of leptin is also thought to be one of the reasons. Leptin is thought to decrease the appetite levels and food intake. It also enhances the activity of deiodinases and also shown to stimulate the transcription of Prothryrotropin releasing hormone (TRH) and thus the TSH.[6]

Subclinical hypothyroidism was considered in the study subjects based on elevated serum TSH levels only. The circulating thyroid antibodies were not checked.

CONCLUSION

The present study suggests that there is a significant association between the serum TSH levels and the anthropometric parameters like BMI, Waist circumference and Waist Hip Ratio. Further studies are planned with inclusion of circulating thyroid antibody levels in the study subjects.

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