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A CROSS-SECTIONAL COMPARATIVE STUDY OF EFFECT OF ALTERED THYROID HORMONE STATUS ON BODY MASS INDEX OF PREMENOPAUSAL WOMEN

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Abstract:

Introduction: Hypothyroid or Hyperthyroid state affects all the physiological systems including cardiovascular system, central nervous system, digestive system, blood, etc. Among all adverse changes, Body Mass Index (BMI) can also be affected in patients with thyroid disorders.
Objectives: The present study was carried out to compare body mass index in newly diagnosed patients of hypothyroidism, hyperthyroidism and age and gender matched euthyroid subjects
Materials and methods: The present study was carried out in 90 female subjects in the age group of 30 to 45**.** Diagnosis of hypothyroidism and hyperthyroidism was based on both clinical and biochemical criteria. Subjects were divided in euthyroid, hypothyroid and hyperthyroid groups with each group containing 30 subjects. BMI was measured in all the groups.
Results: Hypothyroid group had significantly higher BMI as compared to euthyroid group. Hyperthyroid group had significantly lower BMI as compared to euthyroid group. Hypothyroid group had highly significant more BMI as compared to hyperthyroid group
Conclusion: Hypothyroidism subjects are more prone to weight gain and obesity as compared to euthyroid subjects. Hyperthyroid subjects lose more weight as compared to euthyroid subjects. All thyroid disorders should be treated appropriately to maintain normal BMI, failing which the patient can suffer from other undesirable effects of weight gain or weight loss.

Keywords: Body mass index, euthyroid, hypothyroid, hyperthyroid.

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1. INTRODUCTION

Thyroid gland is one of the important endocrine gland in the body. The importance of thyroid gland is based on the fact that the neural growth, development and wellbeing of an individual depends on the maintenance of normal thyroid functions. Thyroid hormones are required for growth and development of the body and maintenance of cell metabolism in general. It helps in tissue maturation of all the organs including central nervous system.[1]

Recently there has been increased prevalence of Thyroid disorder among various endocrinopathies.[2] There is a Global burden of 2 billion cases of thyroid disorders, with more than 40 million in India.[3] Despite increasing knowledge of thyroid physiology and better means for investigation of thyroid functions, we still are at preliminary stage of understanding the pathophysiology of these disorders. Therefore modern physicians are challenged with thyroid disorders due to both hypofunctions and hyperfunctions of the gland. These are grouped as Hypothyroid and Hyperthyroid state respectively.

Hypothyroid or Hyperthyroid state affects all the physiological systems including cardiovascular system, central nervous system, digestive system, blood, etc. Among all adverse changes, Body Mass Index (BMI) can also be affected in patients with thyroid disorders. With this background the present study was carried out to compare body mass index in newly diagnosed patients of hypothyroidism, hyperthyroidism and age and gender matched euthyroid subjects

2. MATERIAL AND METHODS:

The present study was conducted in department of physiology of a government medical college in a urban city after obtaining consent from the institutional ethics committee.

Total of 90 female subjects were selected from the patients attending medicine OPD of a tertiary health care centre and their age matched relatives.

Non-Pregnant females in the age group of 30-45 years with no past history of any thyroid disorders and/or taking treatment for thyroid disorder in the past or present and who were not suffering from any other major illness were included in the present study.

Subjects with history of any other cause of endogenous or exogenous obesity, subjects with diabetes mellitus, hypertension or ischemic heart disease, postmenopausal females, alcoholics and smokers were excluded from the present study.

All the participants were explained verbally in detail about the purpose and every step in the study and a written consent was obtained from all the participants. The detailed medical history was taken and clinical examination was done.

Diagnosis of hypothyroidism and hyperthyroidism was based on both clinical and biochemical criteria. Clinical diagnosis was done by a physician in the OPD of Medicine department.

Biochemical diagnosis was based on total concentration of T3 (Tri-iodothyronine), T4 (Thyroxine) and TSH (Thyroid Stimulating Hormone) in plasma. All the participants were asked to come in the morning at 8 am. They were asked to observe overnight fast before coming for this test. 5ml fasting blood sample was obtained under all aseptic precautions. Serum was separated and serum total T3, T4 and TSH was estimated by using Enzyme linked immunosorbent assay (ELISA) method.

Table 1: Thyroid Hormone profile, Laboratory reference range by ELISA test.

Tests (Parameters)	Expected normal Value
Total T3	56 to 188 ng/dl
Total T4	4.87-11.72 µg/dl
TSH	0.4-4.0µIU/ml

The 90 study participants were then divided into 3 groups as follows:

Table 2: Group wise distribution of study participants

Sr. No	Group	Number of study participants	Thyroid profile	Category
1	I	30	Newly diagnosed patients of hypothyroidism having total Serum T4 less than 4.87 µg/dl, total Serum T3 less than 56 ng/dl and Serum TSH more than 4µIU/ml.	Hypothyroid
2	II	30	newly diagnosed patients of hyperthyroidism having total Serum T4 more than 11.72 µg/dL, total Serum T3 more than 188 ng/dL and Serum TSH less than 0.4µIU/ml.	Hyperthyroid
3	III	30	Age and sex matched healthy controls were selected from the relatives of study group subjects. Their total Serum T4 was between 4.87 to 11.72 µg/dl, total Serum T3 between 56 to 188 ng/dl and Serum TSH between 0.4-4.0µIU/ml.	Euthyroid

Height and weight of participants was noted. Height of participants was measured using a scale inscribed on the wall to nearest centimetre with heels together and heels, calf, buttocks and preferably back touching the wall. The height was measured without footwear. Weight was measured using Krup's weighing machine with subject wearing minimal clothing and without shoes to the nearest kilogram.

Body Mass Index (BMI) / Quetelet's index was calculated using following formula.[4]

$$BMI = \frac{\text{weight in kg}}{(\text{height in meter})^2}$$

Statistical analysis:

Comparisons were performed using one way ANOVA (Analysis Of Variance) for multiple groups and posthoc Bonferroni's multiple comparison Test was applied.

Then Co-efficient of correlation in bivariate relationships was obtained using the Pearson's correlation test.

A ''p'' value of less than 0.05 was considered as statistically significant and "P" value of less than 0.001 as statistically highly significant.

3. RESULTS

Table 3: Comparison of Body Mass Index between Hypothyroid, Hyperthyroid and Euthyroid groups.

Group	Hypothyroid (n=30)	Hyperthyroid (n=30)	Euthyroid (n=30)	ANOVA	
				p value	Significance
BMI(kg/m^2) (Mean ± SD)	23.541.04	21.02±1.51	22.24±2.07	<0.001	S***

BMI= Body Mass Index, SD= Standard Deviation

(S*** - p< 0.001= statistically highly significant)

Graph 1: Comparison of Body Mass Index between Hypothyroid, Hyperthyroid and Euthyroid groups.

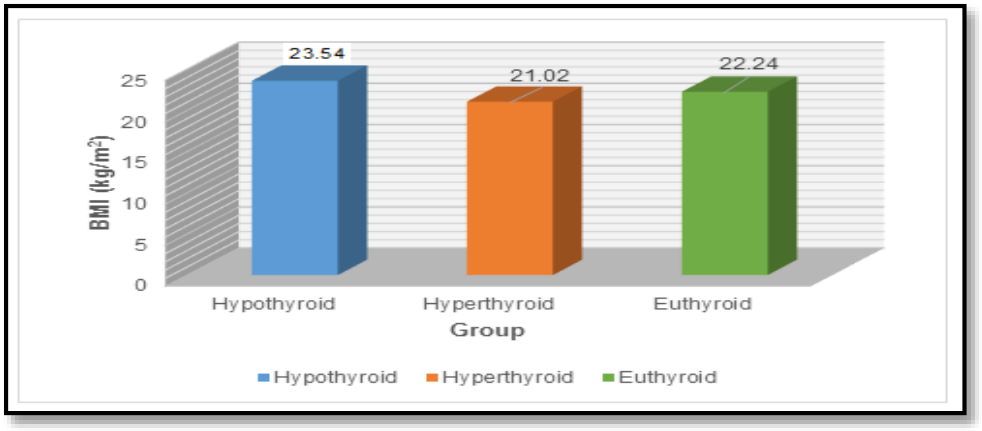

Table 4: Results of Bonferroni's Multiple Comparison Test for Body Mass Index.

Sr. No.	Group	t value	p value	Significance
1.	Euthyroid VS Hypothyroid	3.179	< 0.05	S*
2.	Euthyroid VS Hyperthyroid	2.880	< 0.05	S*
3.	Hypothyroid VS Hyperthyroid	6.058	< 0.001	S***

(S* - p< 0.05= statistically significant)

(S*** - p< 0.001= statistically highly significant)

4. DISCUSSION

In the present study, mean BMI (kg/m^2) was 23.57±1.04, 21.02±1.51 and 22.24±2.0 in hypothyroid, hyperthyroid and euthyroid groups respectively and difference in BMI was found to be statistically highly significant among all the groups. (Table 3)(Graph 1)

Hypothyroid group had significantly higher BMI as compared to euthyroid group. Hyperthyroid group had significantly lower BMI compared to euthyroid group. Hypothyroid group had highly significantly more BMI as compared to hyperthyroid group (Table 4)

Gupta G et al studied a correlation between thyroid stimulating hormone and body mass index in women with subclinical hypothyroidism. The body mass index was significantly higher (28.81±3.47 vs 22.62±1.57) in subclinical hypothyroidism women (<0.001). Also BMI was positively correlated with TSH. He observed increased weight gain in the people with subclinical hypothyroidism. Thereby he concluded that thyroid stimulating hormone affects the body mass index in subclinical hypothyroidism women.[5]

Karthik S et al assessed thyroid profile and body mass index in hyperthyroid compared to hypothyroid subjects and found significant higher BMI in hypothyroid group.[6]

Schneider DF et al studied patients undergoing thyroidectomy for hyperthyroidism. BMI was significantly increased after one year of thyroidectomy in patients of hyperthyroidism.[7]

Pearce EN evaluated the weight in patients of hypothyroidism and found that both serum thyroid-stimulating hormone and T3 were typically increased in obese compared with lean individuals.[8]

Rathi MS et al observed that patients with thyrotoxicosis, especially those with Graves' disease, gain weight for as long as 9 months after becoming euthyroid with antithyroid drug therapy.[9]

Solanki A et al in his study found a significant relationship between serum TSH and BMI. Mean TSH increased as BMI increased.[10]

Kilicaslan B et al evaluated level of TSH in the obese and non-obese subjects and found significantly increased level of TSH in obese subjects. He also found significant correlation between TSH and waist circumference.[11]

The probable reason for this finding is due to the effects of thyroid hormones on various metabolic processes.

1. Basal metabolic rate (BMR): thyroid hormone increases metabolism in almost all the cells of body. This effect probably results from the overall increase in cellular metabolic enzymes caused by thyroid hormone. This results in to stimulation of carbohydrate and fat metabolism.[12,13]
2. Protein metabolism: Thyroid hormones stimulate protein turnover by stimulating both protein synthesis and degradation. This effect is due to stimulation of multiple genes expression by thyroid hormones.[14]
3. Carbohydrate metabolism: thyroid hormone stimulates almost all aspects of carbohydrate metabolism including uptake of glucose by cells, enhanced glycolysis, enhanced gluconeogenesis and increase insulin secretion.[15]
4. Fat metabolism: essentially all the aspect of fat metabolism are also enhanced under the influence of thyroid hormone. In particular, lipids are mobilized rapidly from the fat tissue. This decreases the fat stores of the body to a great extent.[16]

Thus overall effect of thyroid hormone is increase in catabolism.

Therefore in hypothyroidism basal metabolic rate and other metabolic processes are decreased which may fall almost to one-half of normal. This leads to less fat mobilization from fat stores which result in to increased body weight and body mass index as compared to euthyroid state.

While increased thyroid hormone almost always decreases the body weight due to increased rate of catabolism which is due to increase in basal metabolic rate. Excessive quantity of hormone can occasionally increase basal metabolic rate 60 to 100 percent above the normal.

5. CONCLUSION

Hypothyroidism subjects are more prone to weight gain and obesity as compared to euthyroid subjects. Hyper thyroid subjects lose more weight as compared to euthyroid subjects. All thyroid disorders should be treated appropriately to maintain normal BMI, failing which the patient can suffer from other undesirable effects of weight gain or weight loss.

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