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ORIGINAL ARTICLE

COMPARATIVE STUDY ON BMI IN HYPOTHYROIDISM AND HYPERTHYROIDISM PATIENTS

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ABSTRACT

Background of the study: Hormones are chemicals that co-ordinate different functions in your body by carrying messages through your blood to your organs, skin, muscles and other tissues. These signals tell body what to do and when to do it. **Methodology:** This study investigates the comparative effects of hypothyroidism and hyperthyroidism on Body Mass Index (BMI). A total of 100 patients (20-60 years) with diagnosed hypothyroidism or hyperthyroidism were included. BMI was calculated using the standard formula, and thyroid hormone levels (T3, T4, and TSH) were measured. **Result:** The results highlight the significant impact of thyroid disorders on body weight and composition. This underscores the importance of monitoring and managing thyroid health in relation to weight management. **Conclusion:** The study concluded that BMI affects both hyperthyroidism and hypothyroidism patients, with hypothyroidism leading to weight gain due to slowed metabolism and hyperthyroidism resulting in weight loss due to accelerated metabolism. Although the study couldn't definitively prove dissimilar effects between the two conditions due to limited patient availability,

Keywords: Hypothyroidism, Hyperthyroidism, Body Mass Index (BMI), Thyroid Hormones

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INTRODUCTION

Endocrine System: Endocrine system is a network of several glands that create and secrete (release) hormones. Gland is an organ that makes one or more substances, such as hormones digestive juices, sweat or tears. Hormones are chemicals that co-ordinate different functions in your body by carrying messages through your blood to your organs, skin, muscles and other tissues. These signals tell body what to do and when to do it. Hypothalamus, pituitary gland, thyroid, parathyroid glands, adrenal glands, pineal glands, pancreas, ovaries, testes are the organs and glands that makes endocrine system¹.

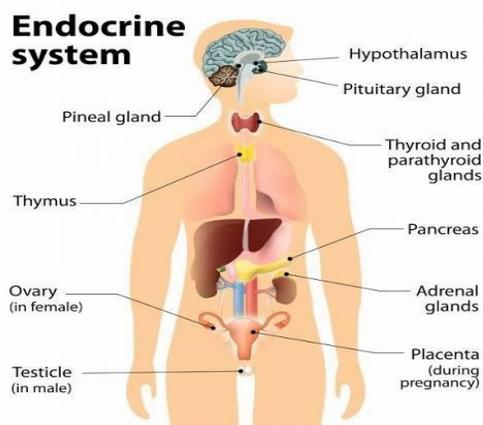


Fig1. Endocrine system

What Is Thyroid? Thyroid is a small butterfly-shaped gland located at the front of your neck under your skin. It's a part of your endocrine system and control many of your body's important functions by producing and releasing (secreting) certain hormones².

Thyroid Anatomy: The Thyroid gland is located in the anterior neck between C5 and T1 vertebrae. It consists of two lobes and parathyroid glands are present on their posterior surface.

Thyroid function: Thyroid stimulating hormones triggers thyroid to release its hormones which mainly impact on body metabolism.

The following are the hormones produced by thyroid; Thyroxine (T4), Triiodo thyronine (T3), Reverse triiodo thyronine(RT3), Calcitonin.

In order to make thyroid hormone, the thyroid gland needs iodine, an element found in food and water. Thyroid gland traps iodine and transforms it into thyroid hormones. If the iodine level is low, it can affect the level of hormone the thyroid makes and releases³.

Thyroxine (T4): This is primary hormone thyroid makes and releases. Thyroid makes the most of this hormone, but it doesn't have much of an effect on metabolism. Once thyroid releases T4 into blood stream, it can convert to T3 through a process called deiodination³.

Thyroxine travels to organs such as kidneys and liver where it gets converted in to its active form triiodo thyronine.

Triiodo thyronine (T3): Thyroid produces lesser amount of T3 than T4, but it has a much greater effect on metabolism than T4.

It is a thyroid hormone that affects physiological processes such as growth, development, metabolism, etc.

Function of Thyroid Hormones:

- Thyroid hormones help with brain development and function.
- It also helps with muscle control as well as bone health.
- Regulates the metabolic rate of your body

- Also regulates the metabolism of fat, proteins and carbohydrates.
- It also helps with protein synthesis.
- Essential for development and differentiation of cells.

How Thyroid hormones levels are controlled:

The production and release of thyroid hormone is controlled by a feedback loop system that involves the following:

- Hypothalamus
 - Pituitary gland
 - Thyroid gland
 - Multiple Hormones
- a) Hypothalamus is the part of your brain that controls function like blood pressure, heart rate, body, temperature and digestion.
 - b) Pituitary gland is a small pea sized gland located at the base of the brain below hypothalamus. It makes and releases nine hormones.
 - c) Pituitary gland is connected to hypothalamus through a stalk of blood vessel and nerves. This is called Pituitary stalk. Through the stalk, your hypothalamus communicates with your pituitary gland and tells it to release certain hormones.
 - d) Hypothalamus releases thyroid releasing hormones which in turn, stimulates your pituitary gland to produce and release thyroid stimulating hormones (TSH).
 - e) TSH then triggers your thyroid to produce T4 and T3. TSH triggers thyroid to release, about 80% is T4 and 20% is T3.
 - f) When the levels of T3 and T4 increase, they prevent the release of TSH.
 - g) When the level of T3 and T4 drops the

loop starts again.

- h) This system allows your body to maintain a constant level of thyroid hormones in our body.
- i) If there are any issues with your hypothalamus, pituitary gland or thyroid, it can result in an imbalance in the hormones involved in this system, including T3 and T4.

Conditions related to abnormal thyroid hormone level:

- Hyperthyroidism (over active thyroid)
- Hashimoto's disease (an autoimmune disease that causes hypothyroidism)
- Hypothyroidism (under active thyroid)
- Grave disease (an auto immune disease that causes Hyperthyroidism)
- Thyroiditis (thyroid inflammation)
- Goiter (enlarged Thyroid Gland)
- Thyroid nodules
- Thyroid cancer.

Hyperthyroidism: It is also called over active thyroid, is when the thyroid gland makes more thyroid hormones than the body needs ⁴.

Symptoms: Fatigue is occasional, Weight loss, Heat intolerance, increased sweating, Rapid or irregular heartbeat, Hyper defecation, nausea and vomiting, Warm and moist skin, hair loss, Nervousness anxiety, difficulty sleeping, Increased appetite, Less common, Muscle weakness, Bulging eyes, vision changes ⁵⁻⁷.

Causes:

Graves' disease

This is the most common cause of hyperthyroidism, is an autoimmune disorder. With this disease, our Immune system attacks

the thyroid and causes it to make too much thyroid hormone.

Overactive thyroid nodules

These are common and usually not cancerous. However, one or more nodules may become overactive and produce too much thyroid hormone. Overactive nodules are found most often in older adults.

Thyroiditis

It is inflammation of thyroid gland. Some types of thyroiditis can cause thyroid hormone to leak out of your thyroid gland into your blood stream. As a result, you may develop symptoms of hyperthyroidism.

Type of thyroiditis that can cause hyperthyroidism: sub-acute thyroiditis, postpartum thyroiditis, painless thyroiditis.

Too much iodine

Consuming large amount of iodine may cause the thyroid to make too much thyroid hormone.

A non-cancerous tumor of the pituitary gland

In some rare cases, a non-cancerous tumor of the pituitary gland, located at the base of the brain, can cause hyperthyroidism.

Complications:

- An irregular heart beat that can lead to blood clots, stroke, heart failure and other heart related problems.
- An eye disease called graves ophthalmopathy
- Thinning bones
- Menstrual cycle and fertility issues

Hypothyroidism: Hypothyroidism is a common condition where the thyroid doesn't create and release enough thyroid hormones into your

blood stream. This makes your metabolism slow down⁵.

Symptoms: Fatigue is common, Weight gain, Cold intolerance, decreased sweat, Slow heart rate, Constipation, Dry skin& hair, Depression, memory problems, excessive sleep, Reduced appetite, Menstrual irregularities is common, Muscle weakness, Puffy eyes, dry eyes

Causes:

Thyroiditis

An inflammation of your thyroid, causes stored thyroid hormone to leak out of your thyroid gland. At first the leak age increases your bloods hormone levels, leading to thyrotoxicosis, a condition in which thyroid hormone levels are too high. The thyrotoxicosis may last for many months. After that, your thyroid may become underactive.

Autoimmune disease: The most common cause of hypothyroidism is an autoimmune disease called Hashimoto's disease. Autoimmune disease happens when the immune system makes antibodies healthy issues. Sometimes that process involves the thyroid gland and affects its ability to make hormones.

Iodine deficiency: Iodine deficiency is a global public health issue, caused by insufficient dietary intake of iodine, leading to thyroid hormone deficiency. It results in severe consequences such as impaired intellectual development, particularly in children, and can cause goiter

Radioactive iodine treatment: Treatment for hyperthyroid is mused radioactive iodine to destroy thyroid cells. This may cause the levels of your thyroid hormone to remain low permanently.

Congenital hypothyroidism: Congenital hypothyroidism is hypothyroidism that present in children from birth. This condition occurs when the thyroid gland develops abnormally or is not present at all. Genetics or iodine deficiency may cause this.

Hereditary condition:

Complication: Heart problems, Goiter, Pregnancy complications, High cholesterol, Myxedema.

Aim: To determine the comparative study on BMI in Hypothyroidism and hyperthyroidism Patients.

Objectives: Collect samples of T3, T4, TSH– Hypothyroidism and Hyperthyroidism patients, Calculation of BMI with known Height and weight.

Samples size is 100, Sample collected from A.C.S Medical College and Hospitals, & Lalithambigai Medical College and Hospital, Chennai. The study conducted for a period of 6Months. Age of above 20to60 had been Included for the study.

Data collection: Approval from the Ethical Committee was obtained. Consent of the person in the study has been taken after briefly explaining the study of process in the own

language. Demographic data of the subject specifically age, Sex, Height, Weight, T3, T4, and TSHlevels were collected and analyzed.

(Patient Data are collected from the medical records). BMI was calculated based on the following formula: $BMI = \text{weight (kg)} / (\text{height (m)})^2$.

Statistical Method Used: We used Descriptive Statistics to Express Count (N) and percentage % for every variable used in this study. Overall Thyroid survey is computed by Mean and Standard Deviation.

Chi-Square test, statistics method used to determine statistically hypothesis test. The test is valid when the test Statistics Is Chi-squared distributed under the Null Hypothesis, Specifically Pearson's Chi-Squared test and Variants thereof.

To inspect the effects between the Hypo and Hyper Thyroid effects among different age group and gender, Chi-Squared test and Variants thereof.

A p-value less than 0.05 is typically considered statistically significant, indicating that there is strong evidence of a relationship between the independent variable and the dependent variable.

Descriptive Statistics

Table 1. Distributions of demographical variables

Variable	Count(N)	Minimum	Maximum	M±SD
Age	100	20	60	38.48±10.78
Height(CM)	100	139	180	159.06±10.3
Weight (KG)	100	37	96	55.64±12.12
BMI	100	15.6	37.5	22.17±5.65
Valid N (Listwise)	100	-	-	-

Above table shows the demographical Variables like Age, Height and Weight, BMI of Hyper-Thyroid and Hypo-Thyroid patients

Table 2. Distribution of Gender

Variable	Categories	Count(N)	Percentage%
Gender	Male	24	24%
	Female	76	76%

Table 2 and describes the distribution of gender in the study, there are 24 males and 76, females.

Table 3.Distributions of Hyper-Thyroid & Hypo-Thyroid

Variable	Hyper Thyroid	Hypothyroid
Male	23	1
Female	27	49

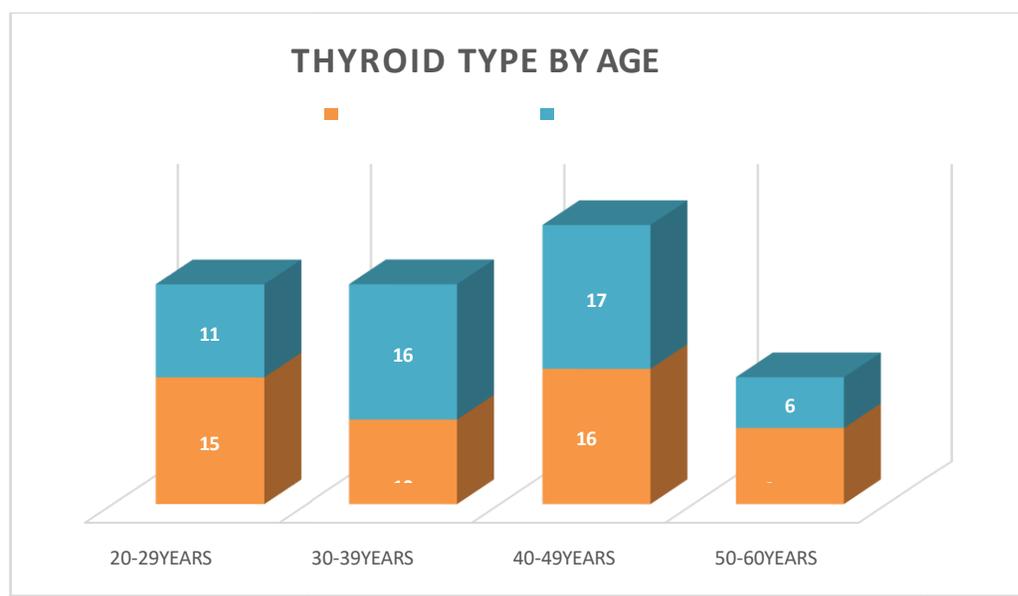
Table .3 describes the number of male female patients in hyperthyroid and hypothyroid

Table.4: Distribution of age and other medical condition:

FREQUENCYTABLE				
Variables	Frequency	Percent	Valid Percent	Cumulative Percent
20-29 Years	26	26%	26	26
30-39 Years	26	26%	26	52
40-49 Years	33	33%	33	85
50-60 Years	15	15%	15	100
Treatment Duration				
<1Year 1-5Years	6	6%	6	6
6-10 Years	15	15%	15	21
>10 Years	15	15%	15	36
	64	64%	64	100
Other Medical Condition	No	71	71%	71
	Yes	29	29%	100
Break in Treatment	No	64	64%	64
	Yes	26	26%	100

Table5: Distribution of Hyper Thyroid & Hypo Thyroid effects by Age

Variable	Hyper Thyroid	Hypothyroid
20-29 Years	15	11
30-39 Years	10	16
40-49 Years	16	17
50-60 Years	9	6



Graph 1. Distribution of Hypo and Hyper thyroid by Age

Table 5 and Graph1 describe the distribution of Hypo and hyper thyroid patients in age wise.

Table 6. Distribution of Hyper Thyroid & Hypo Thyroid by BMI

BMI Range	Hyper Thyroid	Hypothyroid	P VALUE
Overweight	0	50	P<0.000
Normal Weight	0	0	0
Underweight	50	0	P<0.000

Table describes the effect of hypo and hyper thyroid, in which 50 patients were overweight and 50 were underweight.

Table 7. Distribution of Hyper Thyroid & Hypo Thyroid effects:

Variable	P Value significant
Hyperthyroid	0.000
Hypothyroid	0.000

DISCUSSION

Among 100 general populations, majority 76% were Female and 24% were male, in male there were 23 hyperthyroid patients and 1 hypothyroid patient. In Female there were 27 hyperthyroid patients and 49 hypothyroid patients.

Among 100 patients are undergoing the treatment for thyroid we aimed to identify that the effects of hypo and hyper are not always similar

We used descriptive statistics to express count (N) and percentage for every variable used in this study. Overall Thyroid survey is computed by Mean and Standard Deviation. The comparison of Hyper and Hypo are given by Chi Square Test ^{8,9}.

Patients with Hyperthyroidism (N=50) are facing weight loss and patients with Hypothyroidism (n=50) are facing the weight gain.

According to the previous study by Monico Rios Prego, Luis Ani barro and Paula Sanchez-so brino Hypothyroid and hyperthyroid patients after treatment and normalization of thyroid function have statistically significance

change in BMI, but these don't show great relevance in clinical practice because the BMI remind in the overweight in both groups^{10,11}.

In this study, finding shows that, the patient with hyperthyroid is mare facing weight loss and patients with hypothyroidism are facing the weight gain ¹².

CONCLUSION

This study concluded that BMI has effect on both hyperthyroidism and hypothyroidism patients. We were not able to prove that the effects of hypothyroid and hyperthyroid are always not similar, as the appropriate patients are not found. Hypothyroidism patients lead to weight gain due to slowing of the metabolism and other hand Hyperthyroidism speeds up metabolism and causes weight loss

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