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Original Research Article

ROLE OF ANTHROPOMETRIC MARKERS IN HYPOTHYROID & HYPERTHYROID SUBJECTS

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Abstract

Background: The thyroid gland secretes thyroid hormones, which manage the velocity at which the frame's chemical capacities retain (metabolic price). The two thyroid hormones are - T4: Thyroxine (furthermore known as tetraiodothyronine) and T3: Triiodothyronine. Thyroxin (T4) can be a conventional hormone applied around the world to treat hundreds of thousands of sufferers with thyroid clutters. T4 is the most secretory component of the thyroid. A complete or moderate loss of thyroid hormone activity is known as hypothyroidism, which may be undeniable or asymptomatic. Hyperthyroidism, or hyperthyroidism, occurs when the thyroid gland produces more thyroid hormone than the body wants. As a result, the current study's objective is to determine the prevalence of hypothyroidism among the study's participants and those who are overweight or obese. The study also intends to determine whether there is any correlation between obesity as measured by body mass index (BMI), weight, waist circumference, and waist-hip ratio and thyroid function as measured by TSH (thyroid stimulating hormone) levels. The prevalence of weight is extending all-inclusive and one of the basic elements associated with corpulence is concept to be thyroid brokenness. This contemplation pointed to finding the recurrence of hypothyroidism and hyperthyroidism in obese and robust people and to study the relationship between hypothyroidism and hyperthyroidism and anthropometric parameters. **Materials and Methods:** This cross-sectional study was conducted in the Department of Biochemistry in collaboration with the Department of Medicine in Rohilkhand Medical College and Hospital, Bareilly among 150 adults between the age group 20-55 years attending the hospital selected by a systematic random sampling method. To evaluate the laboratory and anthropometric parameters, standard techniques were applied. Before beginning the study, the subjects provided their verbal or written informed consent, and institutional ethics approval was acquired. BMI, Height, weight, hip circumstances, waist circumstances and Waist: Hip ratio were measured using standard protocols according to WHO expert meeting reports (WHO, 1995; WHO, 2000a; WHO/FAO, 2003) Associations of height, weight, and body mass index (BMI) were evaluated using multiple logistic regression models. Taking all aseptic precautions, 5 ml of blood was drawn by venipuncture from a peripheral vein, with a disposable syringe. Samples for thyroid profile (TSH, FT3, FT4) were collected in a plain vial. The blood thus collected in clean dry glass tubes was allowed to stand for 30 minutes at room temperature for the retraction of clots. This was then centrifuged at 3000 r.p.m. to separate the serum for 10 minutes. The serum was stored at 4-8℃ in the refrigerator for further analysis. To avoid haemolysis of samples appropriate care was taken. **Result:** In our study, there was a significant association between hypothyroidism and increased BMI values and weight values. The mean weight of hypothyroid individuals was 65.9 ± 6.6, in hyperthyroid individuals' mean weight was 67.36 ± 5.72 and in euthyroid individuals' mean weight was 59.56 ± 10.68. The mean BMI of hypothyroid individuals was

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26.85 ± 1.9, hyperthyroid individuals, the mean BMI was 27.49 ± 2.40 and euthyroid individual mean BMI was 24.01 ± 3.72. **Conclusion:** The body mass index and weight were shown to be significantly correlated with blood TSH levels. When compared to normal patients, the mean TSH levels were greater in obese people. We have concluded, BMI has a positive correlation with hypothyroidism and a negative correlation with hyperthyroidism.

INTRODUCTION

Thyroid is an important endocrine gland as it primarily governs the rate at which metabolism occurs in the individual cells. Thyroid hormone profoundly influences normal growth and development of the individual. They are essential for mental and psychological development in infancy and early childhood.[1]

The thyroid gland secretes two characteristic hormones –thyroxine and L-tri-iodothyronine these two hormones abbreviated T_4 and T_3 respectively are the derivatives of tyrosine.[2] Secretion of thyroid hormone is regulated by a feedback control mechanism. Thyrotropin releasing hormone (TRH), which is secreted by the hypothalamus, stimulates the anterior pituitary's thyro-tropes to release thyroid stimulating hormone (TSH). When thyroid hormones decrease in plasma, TSH secretion increases and conversely when thyroid hormone increase, TSH secretion decreases.[1]

Thyroid sicknesses are among the commonest endocrine clutters around the world. It is evaluated that around 42 million people in India persevere thyroid diseases.[3] The prevalence and plan of thyroid clutter depend on sex, age, ethnicity, and geographical components.

In India, thyroid problems are the most prevalent endocrine condition, and women are more likely to have hyperthyroidism and hypothyroidism. Functional tests on the goitrous patients revealed a prevalence of 1.9% hyperthyroidism and 5.4% hypothyroidism overall. By using fine needle aspiration biopsy, autoimmune thyroiditis prevalence of 7.5% was demonstrated.[4,5]

Hypothyroidism is defined as a deficiency in thyroid hormone secretion and action. It is a common disorder that occurs in mild and severe forms in 2% to 15% of the population.[6] When the production of T3 and T4 is hampered, whether by an intrinsic flaw in thyroid hormone biosynthesis or by an external source, it leads to primary hypothyroidism. Due to the hypersecretion of TRH and TSH, the positive feedback loop ultimately results in compensatory thyroid hypertrophy.[6] Diseases of the pituitary or the hypothalamus that result in a lack of TSH, TRH, or both can cause secondary hypothyroidism.[6] Hypothyroidism, especially, is the preeminent common thyroid disarranges in India, affecting one in ten adults.[7]

Hypersecretion of thyroid hormone from the thyroid gland or extra thyroidal tissues, which can be generally divided into main and secondary variants, causes hyperthyroidism. In primary hyperthyroidism T_3 & T_4 are high and TSH is low. In secondary hyperthyroidism due to pituitary cause, TSH is high along with high T_3 & T_4.[1]

Thyroid hormones are among the most important humoral factors involved in setting the basal metabolic rate.[8] The thyroid may be an imperative endocrine organ that plays a vital portion in human enhancement. Its assess and shape alter broadly in commonplace individuals. Some factors are included inside the development of the thyroid organ, checking dietary iodine affirmations, age, sexual introduction, smoking and many anthropometric measures.[9,10] The thyroid organ produces thyroid hormones which coordinate the basal absorption framework, and thermogenesis and play a basic portion in lipid and glucose assimilation framework, food affirmations and fat oxidation.[11] Consequently it impacts the by and expansive rate of working of a few organ systems inside the body.

Muscle mass and fat mass cannot be distinguished by the body mass index (BMI). A link between BMI and thyroid function has been shown in several research. Unmistakable thyroid disease is related to checked changes in imperativeness utilize and body weight, with moved forward protein breakdown, lipolysis and customarily weight mishap in hyperthyroidism, and the turnaround in hypothyroidism.[12-14] Anthropometric estimations are an course of action of quantitative estimations utilized to overview the body composition of muscle, bone and fat tissue.

The common anthropometric estimations are weight, height, Body Mass Index (BMI), Skin wrinkle Thickness, Waist circumference and Hip circumference. These estimations are basic since they talk to symptomatic criteria for weight. Body composition and thyroid hormones appear up to be closely related. Body weight is subordinate to distinctive factors. These join genetic makeup of the individual and common inputs like food affirmations and physical development. Body weight and more commonly, weight and hypothyroidism are two common clinical conditions that have been associated together closely. It is watched that changes in thyroid-stimulating hormone (TSH) appear well be assistant to obesity.[15]

The incidence of overweight persons in the population is on the rise globally, which is a serious concern because obesity is a serious public health issue.[16] While some researchers have relied solely on BMI as a measure of obesity, others have used midsection circumference, abdomen hip ratio, and midsection-to-tallness ratio as benchmarks for comparison and evaluation.[17] As a result, the study makes an effort to look into the prevalence of

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hypothyroidism among the subjects it is considering, as well as people who are obese and stout. The investigation also seeks to ascertain whether there is any connection between thyroid function, as indicated by TSH (thyroid enlarging hormone) levels, and corpulence, as indicated by body mass index (BMI), abdominal circumference, and midsection hip ratio.

MATERIALS AND METHODS

This cross-sectional study was conducted in Department of Biochemistry in collaboration with Department of Medicine in Rohilkhand Medical College and Hospital, Bareilly among 150 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. Taking all aseptic precautions, 5 ml of blood was drawn by venipuncture from a peripheral vein, with a disposable syringe. Samples for thyroid profile (TSH, FT3, FT4) were collected in a plain vial. The blood thus collected in clean dry glass tubes was allowed to stand for 30 minutes at room temperature for the retraction of clot. This was then centrifuged at 3000 r.p.m. for 10 minutes to separate the serum. The serum was stored at 4-8℃ in the refrigerator for further analysis. Care was taken to avoid homolysis of samples.

BMI, Height, weight, hip circumstances, waist circumstances and Waist: Hip ratio were measured using standard protocols according to WHO expert meeting reports (WHO, 1995; WHO, 2000a; WHO/FAO, 2003) Associations of height, weight, and body mass index (BMI) were evaluated using multiple logistic regression models.[18]

Anthropometric measurements:

Weight: Body weight (in kg) was measured in light clothing and without shoes. The weight was recorded to the nearest kg.

Height: Height was measured without shoes with the subjects standing fully erect on a flat surface and taken to the nearest centimetre.

Body mass index: Body mass index was calculated by the formula- Weight in kg/ (Height in meter).[2]

Waist circumference: Waist circumference (in centimetre) was measured at midway between the costal margin & iliac crest. After normal expiration, waist circumference was measured.

Hip circumference: Hip circumference (in centimetre) was taken as the largest circumference at the posterior extension of the buttocks (Transtrochantaric).

Waist and hip circumference ratio: Waist and hip circumference ratio was calculated by formula waist circumference/hip circumference in this study protocol.

FT3, FT4 and TSH by ELISA (Enzyme-Linked Immunosorbent Assay). (ERBA Lisa Scan EM - TRANSASIA BIO-MEDICALS LIMITED) (Sr. No-116409) were estimated in all the subjects enrolled in the study.

Inclusion Criteria

Clinically and biochemically analysed hypothyroid and hyperthyroid patients of the two genders old enough 20-55 years, without any set of experiences of thyroxine and any antithyroid medications who visited over the most recent 3 months from both the In-patient and the Out-patient branch of Medicine and Biochemistry, at Rohilkhand Medical College and Hospital, Bareilly, were included in the study.

Exclusion Criteria

- Pregnant women
- Alcoholism - The Dietary Guidelines for Americans suggests that "moderate drinking is viewed as polishing off "up to 1 beverage each day for ladies and up to 2 beverages each day for men" for grown-ups of legitimate drinking age.[19]
- Current Smokers - As per National Survey on Drug Use and Health (NSDUH), a national wellbeing overview supported by the Substance Abuse and Mental Health Services Administration (SAMHSA), on October 19, 2011, current smokers are characterized as somebody who has smoked in excess of 100 cigarettes during their life and has smoked over the most recent 28 days.[20]
- Any individual having history of Diabetes mellitus, Coronary artery disease, Rheumatoid arthritis, Metabolic disorders, other systemic disease (liver disease, renal disease etc.), Post thyroidectomy patients and individuals on heavy drugs, steroids and individuals suffering from cancer-related disorders were excluded.

Ethical Approval: Institutional ethical clearance from the Institutional Ethical Committee (IEC) of Rohilkhand Medical College & Hospital was taken prior to the study (BIU/REG/PhD/411—02/07/2022).

Informed Consent: Informed consent was obtained from all the participants.

Statistical Analysis

In order to examine the relationship between thyroid parameters and anthropometric indices, statistical analysis software such as SPSS Statistics (23.0), ANOVA, t-test along with Pearson's correlation with $P \leq 0.05$ as the level of significance was used.

RESULTS

In our study, out of 150 individuals, 50 were hypothyroid subjects, 50 were hyperthyroid subjects and 50 were euthyroid individuals. It was observed that in our study, among hyperthyroid patients, the maximum study participants 34.0% belonged to 20-30 years and minimum 18.0% belonged to 41-50 years. Among hypothyroid patients, the maximum

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study participants 38.0% belonged to 31-40 years and minimum 10.0% belonged to 51-65 years.

There were more females than males in the present study. Among 50 hyperthyroid patients, there were 24.0% males and 76.0% females. Among 50 hypothyroid patients, there were 26.0% males and 74.0% females. There was a statistically significant association of weight was seen in hypothyroidism & hyperthyroidism as p value<0.001 when compared to euthyroid individuals. The mean weight of hypothyroid individuals was 65.9 ± 6.6 and in hyperthyroid individuals' mean weight was 67.36 ± 5.72. Among hyperthyroid patients, the maximum weight of the study participants 52.0% belonged to 66-75 and minimum 2.0% belonged to 45-55. Among hypothyroid patients, the maximum study participants 52.0% belonged to 66-75 and minimum 4.0% belonged to 76-85. There was also statistically significant association of BMI was seen in hypothyroidism & hyperthyroidism as p value<0.001 when compared to euthyroid individuals. The mean BMI of hypothyroid individuals was 26.85 ± 1.9 and hyperthyroid individuals' BMI was 27.49 ± 2.40. Among hyperthyroid patients, the maximum study participants were 72.0% whose BMI was 25-29 and minimum 8.0% whose BMI was >30. Among hypothyroid patients, the maximum study participants were 80.0% whose BMI was 25-29 and minimum 2.0% whose BMI was ≤18.

Table 1: Distribution of study participants according to age

AGE	Study Parameters					
	Hyperthyroid		Euthyroid		Hypothyroid	
	Count	%	Count	%	Count	%
20-30	17	34.0%	21	42.0%	15	30.0%
31-40	13	26.0%	15	30.0%	19	38.0%
41-50	9	18.0%	7	14.0%	11	22.0%
51-65	11	22.0%	7	14.0%	5	10.0%
Total	50	100.0%	50	100.0%	50	100.0%

Age had no statistically significant association with hyperthyroid and hypothyroid and when compared with euthyroid subjects. Among hyperthyroid patients, the maximum study participants 34.0% belonged to 20-30 years and minimum 18.0% belonged to 41-50 years. Among hypothyroid patients, the maximum study participants 38.0% belonged to 31-40 years and minimum 10.0% belonged to 51-65 years.

Table 2: Distribution of study participants according to gender

SEX	Study Parameters					
	Hyperthyroid		Euthyroid		Hypothyroid	
	Count	%	Count	%	Count	%
Male	12	24.0%	13	26.0%	13	26.0%
Female	38	76.0%	37	74.0%	37	74.0%
Total	50	100.0%	50	100.0%	50	100.0%

Among 50 hyperthyroid patients, there were 24.0% males and 76.0% females. Among 50 euthyroid patients, there were 26.0% males and 74.0% females. Among 50 hypothyroid patients, there were 26.0% males and 74.0% females.

Table 3: Distribution of study participants according to weight

WEIGHT (Kg)	Study Parameters					
	Hyperthyroid		Euthyroid		Hypothyroid	
	Count	%	Count	%	Count	%
45-55	1	2.0%	20	40.0%	4	8.0%
56-65	18	36.0%	17	34.0%	18	36.0%
66-75	26	52.0%	9	18.0%	26	52.0%
76-85	5	10.0%	4	8.0%	2	4.0%
Total	50	100.0%	50	100.0%	50	100.0%
p-value	.000				.000	

Weight had statistically significant association with hyperthyroid and hypothyroid as p-value of both < 0.001 when compared with euthyroid subjects. Among hyperthyroid patients, the maximum weight of the study participants 52.0% belonged to 66-75 kg and minimum 2.0% belonged to 45-55 kg. Among hypothyroid patients, the maximum study participants 52.0% belonged to 66-75 kg and minimum 4.0% belonged to 76-85 kg.

Table 4: Distribution of study participants according to BMI

BMI (Kg/m2)	Study Parameters					
	Hyperthyroid		Euthyroid		Hypothyroid	
	Count	%	Count	%	Count	%
Under weight (≤18)	0	0.0%	13	26.0%	1	2.0%
Normal (18-24)	10	20.0%	20	40.0%	9	18.0%
Over weight (25-29)	36	72.0%	14	28.0%	40	80.0%
Obese (>30)	4	8.0%	3	6.0%	0	0.0%

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Total	50	100.0%	50	100.0%	50	100.0%
p-value	.000				.000	

BMI had statistically significant association with hyperthyroid and hypothyroid as p-value of both is < 0.001 when compared with euthyroid subjects. Among hyperthyroid patients, the maximum study participants were 72.0% whose BMI was 25-29 and minimum 8.0% whose BMI was >30. Among hypothyroid patients, the maximum study participants were 80.0% whose BMI was 25-29 and minimum 2.0% who's BMI was ≤18.

Table 5: Comparison of anthropometric markers in different groups

Anthropometric Markers	Hypothyroidism	Hyperthyroidism	Euthyroidism
	Mean ± SD	Mean ± SD	Mean ± SD
Height (in cm)	156.7 ± 4.0	156.6 ± 4.42	156.98 ± 7.46
Weight (in kg)	65.9 ± 6.6**	67.36 ± 5.72**	59.56 ± 10.68**
Waist circumstances (cm)	84.6 ± 5.9	87.94 ± 7.91	84.58 ± 14.92
Hip circumstances (cm)	92.6 ± 4.4	95.92 ± 7.84	92.10 ± 17.14
Waist: Hip ratio (cm)	0.9 ± 0.34	0.91 ± 0.30	0.89 ± 0.06
BMI kg/M2	26.85 ± 1.9**	27.49 ± 2.40**	24.00 ± 3.72**

** = Statistically significant

The above [Table 5] is showing the anthropometric markers comparison of studied subjects in different groups**.** The mean weight of hypothyroid individuals was 65.9 ± 6.6 and hyperthyroid individuals' mean weight was 67.36 ± 5.72 which was statically significant when compared with euthyroid subjects.

The mean BMI of hypothyroid individuals was 26.85 ± 1.9 and hyperthyroid individuals' BMI was 27.49 ± 2 which was also statically significant when compared with euthyroid subjects.

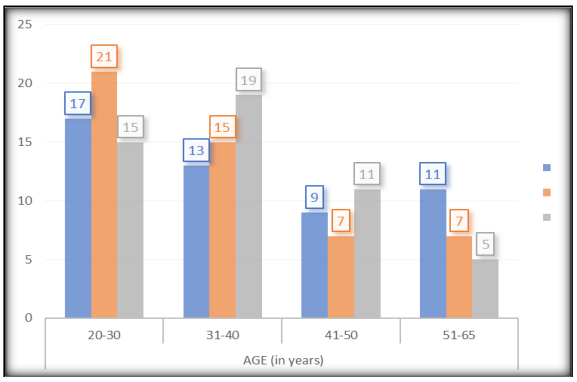

Figure 1: Distribution of study participants according to age

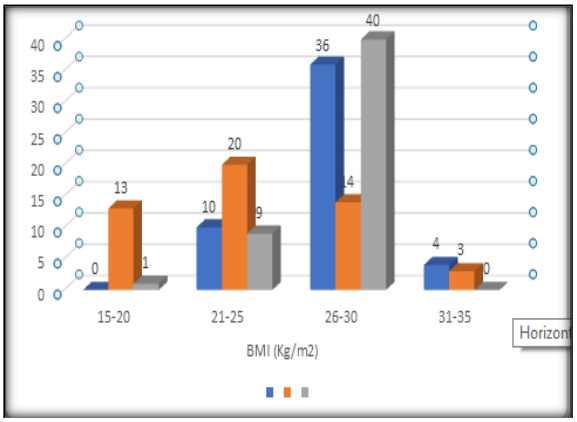

Figure 4: Distribution of study participants according to BMI

DISCUSSION

Thyroid diseases are common throughout the world. Around the world, especially in India, thyroid disorders are a significant burden. According to estimates from numerous studies on the illness, 42 million people in India are estimated to suffer from a thyroid condition. In India, 108 million people are thought to be affected by metabolic and endocrine problems. Due to the influence of environmental variables on many of these ailments, their prevalence is much higher. According to geographic/environmental factors, ethnicity, age, sex, and other characteristics, the prevalence of thyroid dysfunction varies depending on the community. The thyroid hormone is widely known for regulating several body processes, including growth and metabolism. In our study, BMI & weight were statistically significant and found to be high in hypothyroid individuals which are statically significant when compared with euthyroid subjects. The mean BMI of hypothyroid group was 26.85 ± 1.9 and the mean BMI of hyperthyroid group was 27.49 ± 2.40. The mean weight of hypothyroid group was 65.9 ± 6.6 and the mean weight of hyperthyroid group was 67.36 ± 5.67. Shimizu et al. (2020) were reported BMI level of hypothyroidism was 23.4±3.3 and euthyroid group's BMI was 22.7±3.4, which was statistically significant (p-value 0.03).[21] In the study of Lainampetch J. et. al (2019), reported level of BMI (kg/m^2) of hypothyroidism was 25.17 and BMI of hyperthyroidism was 27.08, which was statistically not significant.[22] In another study of Siemińska L et. al; (2015) it was observed that BMI level was 28.77 ± 5.01 in euthyroidism and 29.61 ± 5.07 in hypothyroidism.[23] Saif A et. al; (2018) in their study noted that the level of BMI was 24.0 ± 2.8 in hypothyroidism and 24 ± 2.3 in euthyroidism.[24] Abdulateef and Mahwi (2019) were found the level of BMI was 27.28 in hypothyroidism and 27.00 in euthyroidism.[25] M. Erdogan et. al; (2011) were noted the level of BMI was 29.33±7.46 in hypothyroidism, 30.20±5.82 in overt hypothyroidism and 28.58±6.04 in euthyroidism.[26] Andersen et al. were reported weight was 77 kg of

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patients of hypothyroidism and 81 kg of patients of euthyroidism.[14] Siemińska L et. al; (2015) were observed Waist circumference level was 93.36 ± 12.41 was in euthyroidism and 95.76 ± 12.89 in hypothyroidism.[23] Abdulateef and Mahwi (2019**)** were found the level of waist circumference was 84.88 cm in hypothyroidism and 84.12 cm in euthyroidism.[25] M. Erdogan et. al; (2011) were noted the level of waist circumference was 92.11±13.76 in hypothyroidism, 93.49±12.78 in overt hypothyroidism and 86.41±13.20 in euthyroidism.[26]

CONCLUSION

A highly significant association was found between the serum TSH levels and the Body Mass Index and Weight. The mean TSH levels were higher in the obese when compared to normal subjects. We have concluded, BMI has positive correlation with hypothyroidism and negative correlation with hyperthyroidism. BMI & weight as the anthropomorphic markers might be useful for the selection of hypothyroid & hyperthyroid subjects with the risk of developing thyroid related disorders and will help to clinicians to formulate novel treating protocol & follow up for the patients. Lifestyle modifications & general awareness needs to be created to minimize the risk of thyroid related disorders.

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