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Research Article

# A CROSS SECTIONAL STUDY TO COMPARE THYROID HORMONE VALUES IN NON-OBESE AND OBESE POPULATION IN EASTERN INDIA

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## INTRODUCTION

Obesity is now a leading preventable cause of death worldwide across the age groups [1-3]. The relationship between obesity and thyroid hormones is not yet clearly understood. It is well established that hypothyroidism or hyperthyroidism leads to changes in body weight as thyroid hormones take part in control of thermo genesis and basal metabolism. However, recent studies have found obesity can also influence thyroid function, with increased serum TSH, with or without changes in T3 and T4 concentrations, generally being observed in euthyroid obese subjects [2].It is not yet clear whether change in thyroid function is the cause or consequence of fat excess. Several studies indicate that adipose tissue dysfunction is main factor responsible for changes in homeostasis of thyroid hormones, suggested by observation that weight loss reverses or mitigates these changes.[4]

Hyperleptinemia in obesity stimulates synthesis and secretion of TRH and TSH[5] while simultaneously modulating responsiveness of thyroid gland to TSH, inhibiting iodide uptake and expression of symporter sodium/iodide and thyroglobulin[]. Also, leptininfluences activity of deiodinases, particularly D1(Deiodinase 1) in subcutaneous adipose tissue[7].

Change in expression and activity of deiodinases enzymes, TRα (Thyroid hormone receptor α) and TRβ (Thyroid hormone receptor β) receptors and TSHR (Thyroid Stimulating Hormone receptor) promote a resistance state to action of thyroid hormones[4].

Inflammatory adipokines compromise thyroid function, contributing to morphological changes in the gland. Besides, there is assumption that these adipokines may also alter activity of deiodinases[8].

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Insulin resistance in obesity seems to contribute to the D2 (deiodinase 2) activity reduction in thyrotrophic cells, leading to tissue hypothyroidism and subsequent increase in TSH synthesis[9].

All of these mechanisms lead to changes in serum TSH, T3, and T4, which may lead to an increase in energy expenditure and affect the metabolic regulation of body tissues.[10]

## MATERIALS & METHODS

It was a cross-sectional study done at IPD, OPD of Department of General Medicine, Calcutta National Medical College from March'19 to February'20.A total of 198 persons were recruited in the study. Persons aged between 18 -50 years without thyroid or other hormonal disorder, chronic liver disease, chronic kidney disease, hypertension, diabetes mellitus, hyperlipidemia or other major comorbidities were considered for our study. The study population was divided into two groups:94 persons with BMI between 18.5 to 24.9 and 104 persons with a BMI between 25 to 39.5.Another set of groups was made according to waist circumference where men with >90 cm and women >80 cm of waist circumference were grouped into obese and rest as non-obese.

The statistical software SPSS version 20 has been used for the analysis. An alpha level of 5% has been taken, i.e. if any p-value is less than 0.05 it has been considered as significant.

## RESULT

In our study, the total study population was equally distributed among sexes (50% each male and female). Mean age was 32.62±10.23 years with age range of 18 to 50 years. Mean body weight was 65.67±10.83 kg. Mean BMI was 25.13±3.55. 52.5% of total sample size was comprised of persons with high BMI as per Indian criteria. 31.8% were with normal BMI and 15.7% of total sample were overweight. Total non-obese population was 47.5%.A total of 46.5% of females were non-

obese and 53.5% were obese. Among males,48.5% were non-obese and 51.5% were obese.38.9% of study population had normal waist circumference and 61.1% had high waist circumference. Among females, 36.4% had normal waist circumference and 63.6% had higher waist circumference. For males the percentages were 41.4% and 58.6% respectively. Mean serum TSH level was 2.58±1.54 µIU/ml. Range of serum TSH values was 0.6 to 9.25 µIU/ml. Mean serum level of fT4 1.17±0.29 ng/dl. The range was 0.73 to 3.53 ng/dl. The mean level of serum fT3 was 3.5±0.66 pg/ml (1.24 to 5.5 pg/ml).Mean of waist circumference was 86.16±8.42 cm (66 to 111 cm).Age in non-obese group was 32.38±10.07 years and that in obese group was 32.83±10.41(p value : 0.79).

Serum TSH levels in non-obese and obese groups were 2±1.16 µIU/ml and 3.11±1.65 µIU/ml, respectively (p value of <0.001). The serum fT4 level was1.29±0.34 ng/dl in non-obese group and 1.06±0.19 ng/dl in obese group (p value<0.001).Serum fT3 level in non-obese and obese group was 3.5±0.59 and 3.51±0.72 pg/ml, respectively (p value: 0.904). Serum TSH in subjects with normal waist circumference and high waist circumference were 1.98±1.34 and 2.97±1.64 µIU/ml (p value : <0.001).The serum fT4 levels in subjects with normal and high waist circumference were 1.34±0.34ng/dl and 1.06±0.19ng/dl, respectively (p<0.001). Subjects with normal waist circumference and high waist circumference had a serum fT3 level of 3.47±0.6 and 3.52±0.7 pg/ml (p-Value:0.548).

Serum TSH levels among female were 2.07±1.24µIU/ml and 3.27±1.40µIU/ml, respectively in non-obese and obese groups (p-Value of <0.001) .In case of Male subjects this was 1.95±1.09µIU/ml and 2.94±1.87µIU/ml respectively with p-Value of 0.002. In case of fT4 levels values were 1.29±0.42ng/dl for non-obese and 1.06±0.20ng/dl for obese females with a p-Value of <0.001 i.e statistically significant. In case of male subjects, also, this association was statistically significant with values being 1.29±0.24ng/dl for non obese and 1.06±0.18ng/dl for obese. This association was also statistically significant as the p-Value was <0.001. In both females and males, association between BMI and serum fT3 levels had no statistical significance.

TSH level in females with normal and high waist circumference were 1.76±0.96 and 3.25±1.41µIU/ml, respectively (p-Value <0.001). For males these values were 2.18±1.26 and 2.65±1.81µIU/ml, respectively (p-Value: 0.220). The value of fT4 had also showed statistically significant association with waist circumference both in case of females and males but fT3 had no such significant association.

In our study, BMI in females for age groups of ≤20, 21-30, 31-40 and 41-50 years were respectively 26.09±4.55, 24.43±3.92, 26.54±4.05 and 25.93±3.71 kg/m$^2$. In males values were 25.46±3.22, 24.73±2.81, 24.94±2.66 and 23.91±3.38 kg/m$^2$. Both of these associations had no statistical significance as the p Values were 0.185 and 0.512 respectively. Serum TSH levels in females for age groups of ≤20, 21-30, 31-40 and 41-50 years were respectively 2.58±1.42, 2.70±1.50, 2.74±1.22 and 2.79±1.63µIU/ml (p value: 0.942). Serum TSH levels in males for age groups of ≤20, 21-30, 31-40 and 41-50 years were respectively 2.17±1.50, 2.25±1.24, 2.54±1.59 and 2.79±2.15µIU/ml (p Value: 0.796) . The serum fT4 levels in females for age groups of ≤20, 21-30, 31-40 and 41-50 years were respectively 1.14±0.24, 1.21±0.47, 1.14±0.24 and 1.16±0.25 ng/dl (p value: 0.970).Same in males for age groups of ≤20, 21-30, 31-40 and 41-50 years were respectively 1.14±0.22, 1.13±0.23, 1.16±0.22 and 1.27±0.29 ng/dl (p-Values of 0.291).In our study, serum fT3 levels in females for age groups of ≤20, 21-30, 31-40 and 41-50 years were respectively 3.57±0.51, 3.62±0.72, 3.54±0.46 and 3.42±0.77 pg/ml (p-Values of 0.967) . In our study, serum fT3 levels in males for age groups of ≤20, 21-30, 31-40 and 41-50 years were respectively 3.26±0.67, 3.56±0.74, 3.62±0.57 and 3.21±0.66 pg/ml (p-Values of 0.086).In our study, waist circumference values had no statistical significant association in different age groups in both females and males.

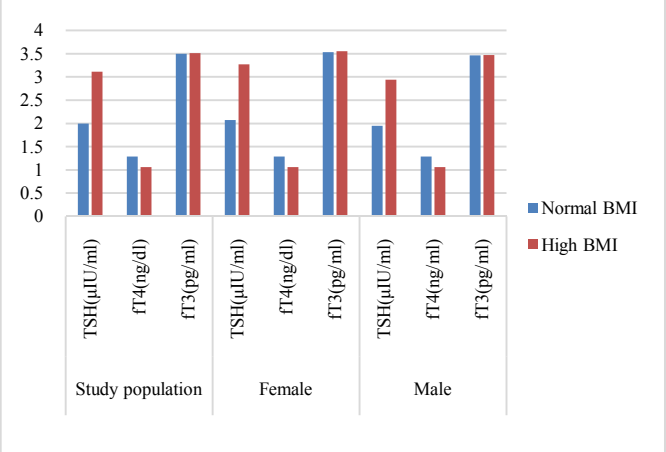


**Fig** 1 Mean serum level of thyroid hormones according to BMI

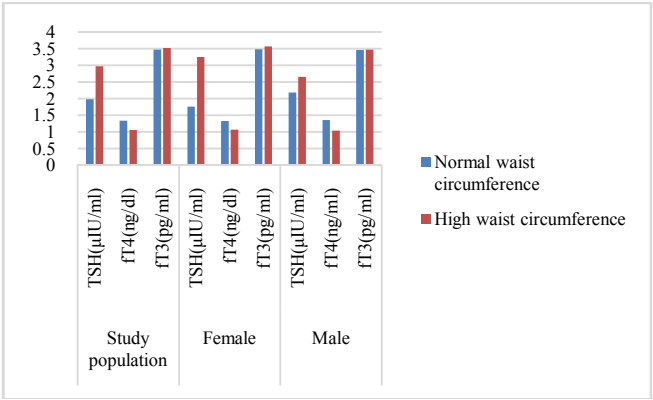


**Fig 2** Mean serum level of thyroid hormones according to waist circumference

## DISCUSSION

In our study range of age of participating subjects was18-50 years. We excluded higher age-group as it is also associated with higher serum TSH level. Serum TSH level of total study population was 2.58±1.54µIU/ml. The serum fT4 of total study population was 1.17±0.29 ng/dl. In one population study[11] the mean was 1.19 ng/dl. The serum level of fT3 of total study population was 3.5±0.66 pg/ml. In case of females as well as males there was no age bias between the groups. Our study showed that serum TSH level was positively related to obesity. Previously, studies[12] showed that serum TSH level was positively related to BMI. The further subgroup analysis showed that in case of females as well as males, serum TSH level was significantly more in obese subjects. In some studies[12], this association was found only in women and in some studies[13,14], this was found only in men. Our study showed that serum fT4 value was lower in obese population. Some previous studies[12,15] showed similar relationship. Some

other studies[16,17] however failed to show any relation between two. This difference is may be due to population under study and influence of confounding factors. Further subgroup analysis showed that in the case of females as well as in males the serum fT4 level was significantly lower in obese subjects. Our study showed that serum fT3 value was irrespective of BMI. Some previous studies[12,16,17] showed the similar result. Further subgroup analysis showed that in case of females as well as in case of males, the serum fT3 level was not related to obesity. This findings (between BMI and fT3) may be explained by the facts that our study population consisted of euthyroid or subclinical hypothyroid eastern Indian subjects. In euthyroid and mild hyopthyroid state the fT3 level remains normal due to increased activity of deiodinase leading to increased conversion of fT4 to fT3. This happens until overt hypothyroidism occurs. As a defence mechanism against further weight gain in case of obese individuals there is increased production of fT3 to increase energy expenditure.[3] Leptin, secreted from adipose tissue also alters the deiodinase activity that also increases the peripheral conversion of fT4 to fT3.[3] In obesity decreased tissue responsiveness to thyroid hormones leads to increased production of fT3.[8] Further more there may be some other genetic or molecular compensatory mechanisms present in euthyroid and subclinical hypothyroid eastern Indian population that is regulating conversion of fT4 to fT3 in such a way that results in normal serum fT3 level in both non-obese and obese subjects in the population . There is no age bias between the groups made according to the waist circumference. In case of females as well as males there was no age bias between the groups. The serum TSH level was positively related to waist circumference. In case of females, serum TSH level was related to waist circumference but in case of males the serum TSH level was not related to waist circumference. Our study showed the serum fT4 value was lower in the high waist circumference group. In some previous studies[15] serum fT4 level was inversely related to waist circumference. In case of females as well as males, serum fT4 level was lower in subjects with high waist circumference. In case of females as well as males, serum fT3 level was not related to waist circumference. We found that BMI was not related to age. Same relationship was found irrespective of gender. Literature[18] showed that there was a positive relationship between age and BMI in both males and females. We did not find any relationship between serum TSH level and age in between 18 to 50 years as a whole as well as gender-wise.The serum fT4 levels was not related to age. Literature[19] suggested that serum fT4 level remains normal with ageing. Gender-wise also there was no relation. Serum fT3 levels was not related to age in between 18 to 50 years. Literature[19] suggested that serum fT3 level remains same with ageing in healthy population. Gender-wise also there was no relationship. We found no relation between waist circumference and age. Literature[19] showed that there was a positive relationship between age and waist circumference in both the sexes.

## CONCLUSIONS

In our study, females with an increased BMI and waist circumference had increased serum TSH level and decreased serum fT4. In case of males, serum TSH level increased with an increase in BMI but serum TSH level was not related to waist circumference. However serum fT4 level decreased with increasing BMI as well as waist circumference. But, serum fT3 level was not related to change in BMI and waist circumference. Our study being single centered study with small sample size, it is not prudent to draw final conclusions for which larger multicentric studies are required.

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