

Original Research Article

Influence of obesity on serum levels of thyroid hormones among Indian adult population

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ABSTRACT

Background: Obesity and thyroid dysfunction are two most common clinical conditions that have been linked together closely in adult. The link has become more relevant in the context of an unprecedented rise in the prevalence of obesity worldwide. Obesity is normally observed by patients as being secondary dysfunction on serum levels of thyroid hormones. Objective: The Purpose of this study to assess serum thyroid hormones levels (fT3, fT4, TSH) variation in patients with obesity and normal thyroid function among Indian adults and to correlate serum levels of thyroid hormones with their classes of Body Mass Index (BMI).

Methods: Authors performed a retrospective study of adult patients who were examined and analyzed serum levels of thyroid hormones at authors centre between February 2018 to November 2019.

Results: A total of 231 adult patients were included. 122(52.8%) were males, mean age was 35.4 ± 10.4 and mean BMI 34.2 ± 5.8 respectively. Obesity was found higher in female 58(53.2%) than male 37(30.3%) participants ($p < 0.001$), respectively. The mean TSH serum levels were significantly increased with increased BMI ($2.04 \pm 1.19, 2.51 \pm 1.22$ and 3.39 ± 1.19 ; $p < 0.001$). No association was found of serum fT4 ($p = 0.227$) and serum fT3 ($p = 0.063$) with BMI.

Conclusions: Mean TSH serum levels showed a significantly increased with increased BMI. BMI was negatively associated with serum fT4 but had no association with serum fT3.

Keywords: Free triiodothyronine and fT4, Indian adult population, Obesity, Thyroid hormones, Thyroid-stimulating hormone

INTRODUCTION

Obesity has become a major public health concern in many countries due to the development of economy and change of lifestyle.¹ As a systemic disease, obesity can result in a series of comorbidities and affect multiple organ functions, including thyroid function.²⁻⁴ The prevalence of obesity has increased worldwide since the mid-1970s. According to the National Health and Nutrition (NIN) examination survey, obesity affected 32.2% of adults in 2003-2004 and reached a peak in

subjects in the fifth decade of life.⁵ In India obesity has reached epidemic proportions in the 21st century with morbid obesity affecting 5% of the country's population.⁶ The prevalence of overweight and obesity has increased over the past decade.⁷ Obesity is an important cause of premature mortality among middle-aged adults.⁸ Some researches have noted a positive correlation between serum Thyroid-Stimulating Hormone (TSH), Triiodothyronine (T3) level, and obesity.^{9,10} Thyroid dysfunction can have clinically significant consequences on appetite and body weight. Hypothyroidism classically

causes reduced basal energy expenditure with weight gain.¹¹ TSH has been reported to be diminished with acute fasting in adults, Free Triiodothyronine (fT3) and fT4 and TSH concentrations were reported to be normal in exogenous obesity.¹² Body composition and thyroid hormones appear to be closely related. Thyroid hormones regulate basal metabolism, thermogenesis and play an important role in lipid and glucose metabolism, food intake and fat oxidation. Thyroid dysfunction is associated with changes in body weight and composition, body temperature and total resting energy expenditure. The Purpose of this study to assess serum thyroid hormones levels (fT3, fT4, TSH) variation in patients with obesity and normal thyroid function among Indian adults and to correlate serum levels of thyroid hormones with their classes of BMI.

METHODS

Study design

Authors performed a retrospective analysis from a prospectively maintained database of patients whom serum samples were analyzed at authors central laboratory of Sri Aurobindo Institute of Medical Sciences between February 2018 to November 2019. A total of 231 adult patients included in this study 122 males, and 109 females. All the demographic and clinical data on free T3, free T4, and TSH were collected. It included sociodemographic variables age (in years), gender, variables related to general information height (in meters), weight (in kg), and Body Mass Index (BMI) was calculated as body weight (kg)/height squared (m^2). Participants were categorized according to their BMI grades as Normal weight: 18.5-24.9 kg/m^2 , Overweight: BMI of 25-29.9 kg/m^2 , Obese: BMI ≥ 30 kg/m^2 and results of laboratory investigations serum levels of TSH, fT3, and fT4 were compared according to their classifications of BMI.¹³

Inclusion criteria

- Participants were being an adult.

exclusion criteria

- The exclusion criteria comprised subjects with any past or present history of thyroid illness, cigarette smokers, patients with chronic liver or renal disease, pregnancy, or taking any drug altering serum TSH levels (e.g., metformin).

Statically analysis

All the data were entered in Microsoft excel sheet and statically analysis by GraphPad. Descriptive statistics were calculated and the appropriate tests of significance (i.e., chi square or ANOVA) were applied accordingly. Differences were considered as statistically significant when *p* value was less than 0.05.

RESULTS

A total of 231 adult patients included in this study 122 (52.8%) males, and 109 females (47.1%). No significant differences were observed in age, BMI and thyroid hormones serum levels, according to the gender. The mean age was 35.2 ± 12.3 in male, 35.6 ± 9.7 in female and mean BMI 32.4 ± 5.6 in male 33.9 ± 5.7 in female. The detail of thyroid hormones serum levels (TSH, fT3, and fT4) were shown in table 1. Normal weight participants were 34(27.8%) male and 24(22.0%) female and Overweight 51(41.8%) male and 27(24.7%) female.

Obesity was significantly higher in female 58(53.2%) than male 37(30.3%) participants ($p < 0.001$). None of the participants was underweight. (Table 2).

Table 1: Age, body mass index, and thyroid hormones serum levels (mean \pm sd) according to participants' gender.

	Male (n=122)	Female (n=109)	Total	<i>p</i> value
Age (years)	35.2 ± 12.3	35.6 ± 9.7	35.4 ± 10.5	0.284
BMI (kg/m^2)	32.4 ± 5.6	33.9 ± 5.7	34.2 ± 5.8	0.063
fT3 (pmol/l)	4.32 ± 1.69	4.14 ± 1.06	4.24 ± 1.42	0.193
fT4 (pmol/l)	10.6 ± 4.9	11.6 ± 3.9	11.1 ± 4.2	0.083
TSH (mIU/l)	2.83 ± 1.34	2.75 ± 1.29	2.79 ± 1.32	0.182
BMI (kg/m^2): body mass index; fT3: free triiodothyronine; fT4: free thyroxine TSH: thyroid-stimulating hormone				

Table 2: Grades of body mass index according to participants' gender.

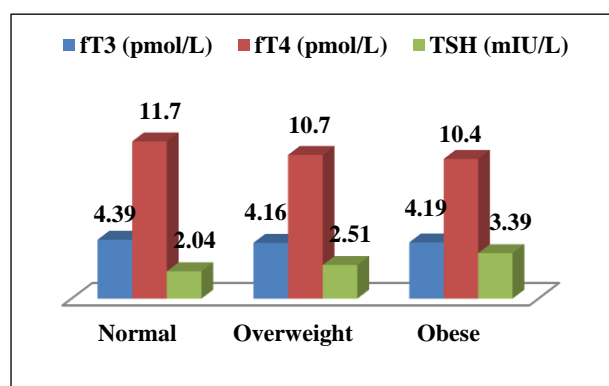
Classification of BMI	Male (n=122)	Female (n=109)	Total (n=231)
Normal weight (18.5-24.9 kg/m^2)	34(27.8%)	24(22.0%)	58(25.1%)
Overweight (25-29.9 kg/m^2)	51(41.8%)	27(24.7%)	78(33.7%)
Obese (>30 kg/m^2)	37(30.3%)	58(53.2%)	95(41.1%)

Table 3: Thyroid hormones serum levels according to participants' body mass index.

Thyroid hormones	Normal (n=58)	Overweight (n=78)	Obese (n=95)	p value
FT3 (pmol/L)	4.39±1.48	4.16±1.43	4.19±1.39	0.227
FT4 (pmol/L)	11.7±4.2	10.7±4.8	10.4±4.6	0.063
TSH (mIU/L)	2.04±1.19	2.51±1.22	3.39±1.19	<0.001

ft3: free triiodothyronine; ft4: free thyroxine; TSH: thyroid-stimulating hormone

No significant differences were observed in serum ft3 and mean serum ft4 levels according to BMI. TSH serum level of normal weight participants was 2.04±1.19 mIU/L, that of overweight participants was 2.51±1.22 mIU/L, and that of obese participants was 3.39±1.19 mIU/L (Figure 1). Mean TSH serum levels showed a significantly increasing with increasing BMI ($p<0.001$). The highest ft4 levels among participants with normal BMI and lowest among obese participants (11.7±4.2 pmol/L, 10.4±4.6 pmol/L). No significant difference was observed regarding participants' mean serum levels of ft4 with their BMI (Table 3).

**Figure 1: ft3, ft4 and TSH levels according to BMI.**

DISCUSSION

In obese patients increased TSH levels to be found without a history of thyroid disease. The present study suggests that the increased TSH found in obesity is secondary to the obese state. In present study TSH serum levels showed a significantly increasing with increasing BMI. However, no significant associations between male or female participants' serum ft3 or ft4 with their BMI classifications. These findings are in accordance with those of Solanki et al, who reported a significant positive association between participants' BMI and their TSH mean serum levels. By Knudsen et al, indicated that serum TSH is positively correlated with BMI, suggesting a state of possible subclinical hypothyroidism, that is, the presence of raised serum TSH levels despite the presence of serum hormone concentrations within the normal range.^{14,15} The association between TSH and BMI by Chan et al, to be under the influence of adipose tissue signals and leptin may have significant effects on central regulation of thyroid function through TRH. Zimmermann-Belsing et al, suggested that a

positive correlation between serum leptin and TSH also indicates a positive correlation between BMI and TSH.^{16,17} Valyasevi et al, explained the association between TSH and BMI by that TSH may directly stimulate preadipocyte differentiation resulting in adipogenesis. In this study significant differences were observed in serum ft3 and mean serum ft4 levels according to BMI Normal weight participants were 34(27.8%) in male and 24(22.0%) in female and Overweight 51(41.8%) vs 27(24.7%).¹⁸ Obesity was significantly higher in female 58(53.2%) and in male 37(30.3%) participants ($p<0.001$). Rotondi et al, added that the impact of bodyweight on thyroid differs according to lower grades of overweight and morbid obesity. In contrast, Manji et al, and Figueroa et al, found no correlation between BMI and serum levels of any of the thyroid hormones in euthyroid individuals.^{19,20} No significant differences were observed in serum ft3 and mean serum ft4 levels according to BMI in present study. Similarly, Tarim reported that ft3 and ft4 were normal in obese subjects.¹² Solanki et al, found that BMI was negatively associated with serum ft4 but had no association with serum ft3.¹⁴ Furthermore, Roos et al, reported that serum ft4 was negatively associated with BMI. In addition, Iacobellis et al, reported that, in morbidly obese women, lower ft4 values were accompanied by higher BMI values, but no association between BMI and ft3 was found.^{21,22}

CONCLUSION

Associated with normal weight individuals, overweight individuals are more likely to have high serum concentrations of ft3 and low concentrations of ft4; obese individuals are more likely to have high concentrations of TSH and ft3/ft4; and underweight individuals are more likely to have high concentrations of ft4 and low concentrations of ft3. Relationship TSH levels are positively correlated with the degree of obesity and some of its metabolic effect in overweight people with normal thyroid function, which suggest that thyroid function is one factor that influences BMI and the development of co-morbidities of obesity. This study found that mean TSH serum levels increase with BMI increase and BMI was negatively associated with serum ft4 but had no association with serum ft3. Obesity was significantly higher in female than male. Further longitudinal studies are required to determine whether these are causal relationships, and more research is needed to determine whether interventions should be recommended to reduce the unfavorable effects of HPT axis dysregulation in obesity.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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