

## Study on Body Mass Index and Thyroid Hormones in Euthyroid Saudi Adults

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**Abstract:** Obesity is defined as an excess of body adiposity and its prevalence is increasing at an alarming rate. This analysis was carried out on almost 100 obese and overweight women aged 25 to 53 years. A pre-structured and pre-tested questionnaire was used to gather demographic information, personal and family medical history. Anthropometric measurements, blood pressure measurements and biochemical analysis were carried out. As compared to the overweight the mean of the waist was statistically and significantly higher in obese subjects. Similarly the mean of fat ratio was also statistically and significantly higher in obese subjects. As compared to the obese group the systolic and diastolic blood pressure was insignificantly lower in the overweight group. It was found that the obese had higher level of TSH but the difference was insignificant between the groups. The FT4 level was insignificantly lowered in obese but total T4 level was significantly higher in obese group. In conclusion the connotation between thyroid hormones and metabolic risk markers were recognized which recommends that thyroid function might be one of numerous factors that influence body weight and discrepancies of normal thyroid function are accompanied by differences in BMI.

**Key words:** Body Mass Index • Thyroid Hormones • Weight • Thyroid Stimulating Hormone

### INTRODUCTION

Obesity is a major health threat globally [1]. The Gulf Cooperation Council (GCC) countries including Saudi Arabia is not any exception, since even in these countries the incident of overweight ranges between 25%-50% and the occurrence of obesity ranges between 10%-50% and was found to be relatively higher in women increasing with an upsurge in age [2]. The international focus on obesity has ensued in a rapid upsurge in the findings dealing with possible connections between obesity and other diseases. It also focuses in finding the relation between obesity and physiology and pathophysiology of different body organs and tissues [3]. The interrelationships between body weight and thyroid status are complex [4].

It is well known that thyroid hormones (TH) affect metabolic rate. Amin *et al.*, suggested that TH may access the arcuate nucleus and other hypothalamus regions to regulate appetite [5]. Additionally; it has been identified that dysfunction of thyroid can have clinically noteworthy consequences on body weight and appetite [6]. Despite the fact that findings on TH in overweight

and obese adults are varying, Koritschoner *et al.* [7] has reported that animal experiments have shown a correlation between TH and changes in weight [7]. Epidemiological data showed a higher occurrence (~20%) of overt and subclinical hypothyroidism in morbid obese individuals [8]. There are some studies which found that although TSH values range may differ in diverse populations, the usual finding is that TSH levels associate with weight of the body [9, 10, 11]. Various studies have reported that baseline serum TSH levels are usually in the upper limit (or slightly over it) of the normal range in euthyroid obese individuals [9, 12-18]. Additionally, the rise in TSH concentrations is related with raised waist circumference and BMI [19, 20]. Data from Saudi Arabia in this regard is limited. The present study is aimed to evaluate T4, FT4 and TSH concentrations among overweight and obese subjects and effect of BMI on these markers.

### MATERIALS AND METHODS

**Subjects:** This analysis was carried out on 100 obese and overweight women aged 25 to 53 years. A pre-structured and pre-tested questionnaire was used to gather

demographic information, personal and family medical history. Informed consent was obtained from all participants. Subjects with a history of smoking, chronic renal failure, polycystic ovary syndrome, thyroid disease, were excluded from the study. Subjects taking antihypertensive drugs and statins, contraceptive drugs were also excluded from the study.

**Anthropometric Measurements:** Height and weight were measured in light clothing without shoes. Body height was measured by a stamometer and body weight by digital electronic weighing scale.

The BMI was defined as the body mass divided by the square of the body height and is universally expressed in units of kg/m<sup>2</sup>.

Waist circumferences were measured midway between the xiphoid and the umbilicus during the mid-inspiratory phase using a flexible measuring tape. All measurements were repeated thrice.

**Blood Pressure:** The average of two measurements of blood pressure (BP) with the subject in the sitting position was taken at a 2 to 3 min interval after resting for at least 15 min.

**Biochemical Analysis:** Serum levels of fasting glucose, triglycerides (TG), total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL) and uric acid were analyzed with commercial kits (Beckman -Coulter, USA), while the levels of serum FT4 and TSH, were determined in an immunanalyzer [21].

**Statistical Analysis:** Statistical Package for the Social Sciences (SPSS) software package v25 (IBM, Chicago, IL, USA) was used for analyzing the data. Results have been reported as mean ± standard deviation. Statistical comparisons between the groups were achieved with T test.

## RESULTS

In this study 100 women were recruited, with a mean age of 33.12 ±8.64 years and a mean BMI of 32.12 ±5.41. The mean for the waist was 88.38 ±10.44 cm and the averages of systolic and diastolic BP were within the normal levels at 102.12±11.10 mmHg and 72.34±8.78 mmHg respectively. The thyroid function tests were done and the outcomes showed that the mean of the TSH, FT4 and total T4 level were 2.38±1.38, 11.99±2.56 and 88.22±11.47 respectively. The lipid profile as well as the glucose, iron and uric acid levels was estimated and the data is shown in Table 1.

Table 2 shows the results for the variance in the variables of the sample based on the differences in BMI. The mean of the waist was statistically and significantly higher in obese subjects (93.74±10.54) as compared to the overweight (82.08±5.81). Similarly the mean of fat ratio was statistically and significantly higher in obese subjects (42.08 ±3.76) as compared to the overweight (35.90 ±3.02). Systolic and diastolic BP was insignificantly lower in the overweight group. It was found that as compared to the overweight subjects (2.23±1.33) the obese had higher level of TSH (2.51±1.41), but the difference was

Table 1: Distribution for all the study sample

Variable	Mean± Std. Deviation	Minimum	Maximum
Age (years)	33.12 ±8.64	19	53
Height (cm)	160.41±5.98	147	176
Weight (kg)	82.46±15.01	55.70	124.00
BMI	32.03±5.42	24.82	45.00
Waist (cm)	88.38±10.44	71	117
Fat ratio	39.24±4.62	29.80	50.30
Systolic BP (mmHg)	102.12±11.10	75	131
Diastolic BP (mmHg)	72.34±8.78	40	92
Cholesterol (mg/dL)	194.67±34.94	133	283
Triglyceride (mg/dL)	107.83±51.41	38	316
HDL (mg/dL)	41.27±8.21	25	63
LDL (mg/dL)	130.42±25.72	72	192
Uric Acid (mg/dL)	5.03±1.22	1.50	7.40
Glucose (mg/dL)	99.55±14.70	66	196
Iron (mcg/dL)	68.41±26.01	21	176
TSH (mIU/l)	2.38±1.38	0.50	6.70
FT4 (pmol/l)	11.99±2.56	7.70	19.40
Total T4 (pmol/l)	88.22±11.47	68.10	119.30

Where BMI- Body Mass Index; HDL-High density lipoprotein; LDL-Low density lipoprotein, TSH-Thyroid stimulating hormone; FT4- Free thyroxine

NS- non significant

\*Significant at p ≤0.01

\*\* Significant at p ≤0.05

Table 2: Differences in variable of the sample based on the differences in the level of body mass index (BMI)

Variable	Overweight group (from 25 to 30) (n=46)	Obese group (over 30) (n=54)	P-value
Age (years)	32.89±8.25	33.31 ±9.04	0.809 <sup>NS</sup>
Height (cm)	161.70±6.33	159.32 ±5.48	0.046**
Weight (kg)	72.44 ±7.19	91.00±14.68	0.000*
Waist (cm)	82.08±5.81	93.74 ±10.54	0.000*
Fat ratio	35.90 ±3.02	42.08 ±3.76	0.000*
Systolic BP (mmHg)	101.57 ±10.73	102.59 ±11.49	0.647 <sup>NS</sup>
Diastolic BP (mmHg)	71.11±8.09	73.39±9.29	0.197 <sup>NS</sup>
Cholesterol (mg/dL)	190.52±34.21	198.20±35.48	0.275 <sup>NS</sup>
Triglyceride (mg/dL)	96.78±34.93	117.24±60.87	0.039**
HDL (mg/dL)	42.11±7.43	40.56±8.83	0.349 <sup>NS</sup>
LDL (mg/dL)	129.57±23.85	131.15 ±27.42	0.761 <sup>NS</sup>
Uric Acid (mg/dL)	4.82 ±0.95	5.21 ±1.40	0.103 <sup>NS</sup>
Glucose (mg/dL)	97.70 ±10.08	101.13 ±17.65	0.246 <sup>NS</sup>
Iron (mcg/dL)	73.00 ±29.82	64.50±21.78	0.104 <sup>NS</sup>
TSH (mIU/l)	2.23±1.33	2.51±1.41	0.300 <sup>NS</sup>
FT4 (pmol/l)	12.05±2.42	11.94 ±2.7	0.821 <sup>NS</sup>
Total T4 (pmol/l)	83.48 ±9.32	91.38±11.85	0.031**

Where BMI- Body Mass Index; HDL-High density lipoprotein; LDL-Low density lipoprotein, TSH-Thyroid stimulating hormone; FT4- Free thyroxine  
NS- non significant

\*Significant at  $p \leq 0.01$

\*\* Significant at  $p \leq 0.05$

insignificant between the groups. The FT4 level was insignificantly lower in obese (11.94±2.7) compared to overweight participants (12.05±2.42). Total T4 level was significantly higher in obese group (91.38 ±11.85) than overweight group (83.48±9.32).

## DISCUSSION

The serum concentrations of TSH and total T4 (TT4) was higher in obese group, while FT4 was lesser in obese group when compared to overweight group. Numerous studies have stated that TSH levels are at the higher limit of the normal range or slightly more in obese children, adolescents and adults and are positively associated with BMI which is in accordance with this result [9, 22-25]. Evidences advocates that minor difference in thyroid function, (even as shown by laboratory tests that are within reference ranges), leads to the progression of regional obesity and the propensity to gain weight [26], although this finding has not been confirmed by all studies [27]. Knudsen *et al.*, reported that there is a negative connotation between serum free T4 (FT4) and BMI [26] and the accretion of fat has been related with lower FT4 [26, 28] and higher TSH levels among slightly overweight euthyroid individuals [20, 26, 28, 29] thereby leading in a positive connotation between TSH level and upsurge in the weight [20].

Researchers stated that receptors of TSH are less expressed on adipocytes of obese subjects vs. lean individuals despite the higher plasma TSH levels [30] and abridged TSH receptor expression might be responsible for further increasing the concentration of plasma TSH and FT3 and creating a condition of peripheral TH resistance by inducing down-regulation of TH receptors and TH action [25]. In line with these finding many studies reported that; usually abnormal function of TH and TSH level normalizes after reduction in weight [22-25, 31].

Significant increase in TSH level has been reported previously with increase in BMI [32]. Free T4 has been found to be negatively correlated with BMI in euthyroid women [33]. Findings in regards to TT4 were similar to that of Milionis and Milionis who reported that BMI was significantly positively correlated with TT4 in female patients [34].

## CONCLUSION

Thyroid stimulating hormone was higher in subjects with higher BMI but increase was statistically insignificant. TT4 was significantly related with BMI, while FT4 was insignificantly lesser in obese group than overweight group. In conclusion the connotation between thyroid hormones and metabolic risk markers were

recognized which recommends that thyroid function might be one of numerous factors that influence body weight and discrepancies of normal thyroid function are accompanied by differences in BMI.

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