

Association between Obesity and Thyroid Hormone Levels among Saudi Arabian Patients

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Abstract:-

Introduction: Obesity epidemic is a major health-care problem. The thyroid hormone affects weight status through modulation of the Resting Energy Expenditure. This is done through the adaptive thermogenesis, the Na/K pump, glucose entry through GLUT-4 transporter, and through effects on the cardiac muscle. Studies conflict on the effect of obesity on the thyroid hormone function; some studies found a positive correlation even after excluding thyroid disorders, but others did not. Although obesity can explain the co-occurrence of coronary artery disease and diabetes mellitus, the influence of the thyroid hormone needs further clarification. In this study, we explore the association between obesity and thyroid hormone levels and the effect of the thyroid hormone on comorbidities.

Methodology: This is a retrospective cross-sectional study that included hospitalized patients in the Endocrinology department of King Fahd Hospital between January 2016 and January 2017. Patient files were searched for age, gender, co-morbidities, chronic medications, TSH, free T3, free T4, and BMI. Patient with endocrinologic disease, thyroid disease, cancer; and women who are pregnant or on Oral Contraceptive Pills were excluded from the study. Data was analyzed using SPSS version 23. Frequencies, descriptive statistics and multiple linear regression were performed looking for statistically significant associations.

Results: We studied 334 Saudi Arabian participants, 66.7% of whom were females. The mean age among our patients was 49 years. Twenty five percent of our patients had a normal BMI, 30.8% were overweight, and 42.8% were obese. Sixty three percent of our participants had abnormal TSH level, 22% had abnormal T3, and 21.5% had abnormal T4. About half of our patients had at least one comorbidity. Multiple linear regression analysis was done, with BMI as the outcome variable and TSH, T3, and T4 as the predictive variables. It did not reveal any significant association.

Discussion: Although many studies report an association between obesity and the thyroid function, many others, including our study, did not. This can be attributed to different laboratories, methodologies and sample sizes. Our studied population was leaner on average than other studies. Although it is not clear whether different obesity levels have different effect on the thyroid

function, an association was detected in more obese populations.

I. INTRODUCTION

Obesity epidemic is becoming a major health-care problem as the availability of high energy food is increasing in the modern society. It is associated with diabetes mellitus, coronary artery disease, cancer and certain sleep disorders ^[1]. Although the main causes of obesity are genetic predisposition, inadequate diet and lack of exercise, certain metabolic factors come into play.

Weight status is determined by physical activity and the Resting Energy Expenditure (REE), and the thyroid hormone modulates it through many mechanisms. The thyroid hormone is a critical element in adaptive thermogenesis. This process occurs in the skeletal muscles and is mediated via the uncoupling of oxidative phosphorylation, which generates heat energy. As adaptive thermogenesis is mediated by locally produced thyroid hormone, serum T3 level is not affected. The thyroid hormone also regulates the Na/K ATPase, glucose entry via GLUT-4 transporter, as well as the cardiac muscle action ^[2].

While it is known that thyroid disorders affect body weight, the effect of obesity on thyroid hormone levels is subject to much debate. Many studies on obese patients report a positive correlation between TSH and Body Mass Index (BMI) ^[3, 4, 5, 6]. Other studies reported the same findings even after excluding clinically significant hypothyroidism ^[7, 8]. Other studies, however, did not report statistically significant findings ^[9, 10, 11].

Several theories explain the increased TSH level among obese people. Pathologies in the thyroid ^[7, 8, 12] and the pituitary gland ^[8] were ruled out in several studies. Studies in obesity found a decrease in T3 receptors ^[13], and the lack of negative feedback on TSH since T3 levels were also elevated ^[8, 12]. Since a decrease in TSH is observed in patients with Anorexia Nervosa ^[14] (in which BMI is less than 18.5), TSH change in obesity can be regarded as a compensation to the low Resting Energy Expenditure in obesity.

Obesity by itself can explain the occurrence of coronary artery disease and diabetes mellitus, but the thyroid hormone is linked to insulin resistance in many studies [15, 16]. The association between TSH level and the presence of comorbidities in obese patients was not sufficiently studied. In this study, we aimed to investigate the association between thyroid hormone levels and BMI among a group of Saudi Arabian patients. We also aim to investigate the association between selected comorbidities and the thyroid hormone level.

II. MATERIAL AND METHODS

This study is a retrospective, descriptive cross-sectional, hospital-based study. It was conducted on Saudi Arabian patients who presented to King Fahd Hospital out-patient clinics during the period from January 2016 and January 2017.

After obtaining the ethical approval from we included all patients who presented during the aforementioned period. We excluded patients with any disease of the endocrine system (thyroid disease patients, others), patients with cancer, women who are pregnant, and women who take oral contraceptive pills.

We searched patient files and used a structured data collection sheet to collect data on age, gender, comorbidities, chronic medications, TSH level, T3 level, T4

level, and BMI. We entered our data in SPSS version 23 for statistical analysis. We reported frequencies, descriptive statistics, and multiple linear regression analysis results through tables and figures.

III. RESULTS

The total number of our study participants was 334, of whom, 223 (66.7 %) were females. Twenty five percent of our patients had a normal BMI, 30.8% were overweight, and 42.8% were obese. Sixty three percent of our participants had abnormal TSH level, 22% had abnormal T3, and 21.5% had abnormal T4. Table 1

The age of our patients ranged from 15 to 96 years, with an overall mean of 49 years (SD= 15.9), a mean of 52 years (SD= 14.5) among patients who have comorbidities, and 46 years (SD= 16.7) among patients who do not. Table 2

Among our patients, 158 (47.3%) had at least one associated comorbid condition, the most common of which was hypertension in 52%, followed by diabetes mellitus in 51%, and asthma in 16% patients. The most common prescribed medications were metformin in 32%, Angiotensin II receptor antagonists in 23%, statins in 22%, gliclazide in 18%, and ACE inhibitors in 16%.

Table 1: Body

Mass Indexes and Thyroid Hormone levels among the study participants (n= 334)

Variable	Number	Percentage
TSH level*	Low (< 0.3)	44
	Normal (0.3 – 3.5)	124
	High (> 3.5)	166
Free T3 level**	Low (< 3.5)	55
	Normal (3.5 – 7.5)	261
	High (> 7.5)	18
Free T4 level**	Low (<10)	31
	Normal (10-25)	262
	High (> 25)	41
BMI***	Underweight (<18.5)	4
	Normal (18.5-24.9)	84
	Overweight (25-29.9)	103
	Obese (>29.9)	143

*Measurement unit is mu/l

**Measurement unit is ng/d

***Measurement unit is Kg/m²

Table 2: Mean thyroid function test result and body mass index in patients with and without comorbidities (n= 334)

	With comorbidities	Without comorbidities
TSH*	4.7 (SD= 4.3)	4.4 (SD= 4.3)
Free T3**	5 (SD= 1.6)	4.9 (SD= 1.9)
Free T4**	18 (SD= 6.1)	16.7 (SD= 7.2)
BMI***	28 (SD= 5.8)	30 (SD= 6.5)

*Measurement unit is mu/l

**Measurement unit is ng/d

***Measurement unit is Kg/m²

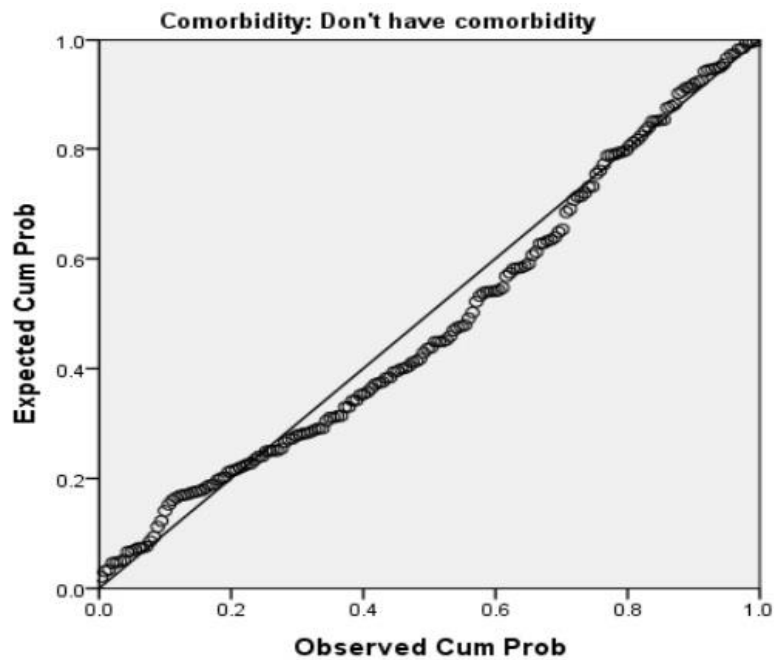


Figure (1): The distribution pattern of the BMI P-Plot among patients without comorbidities

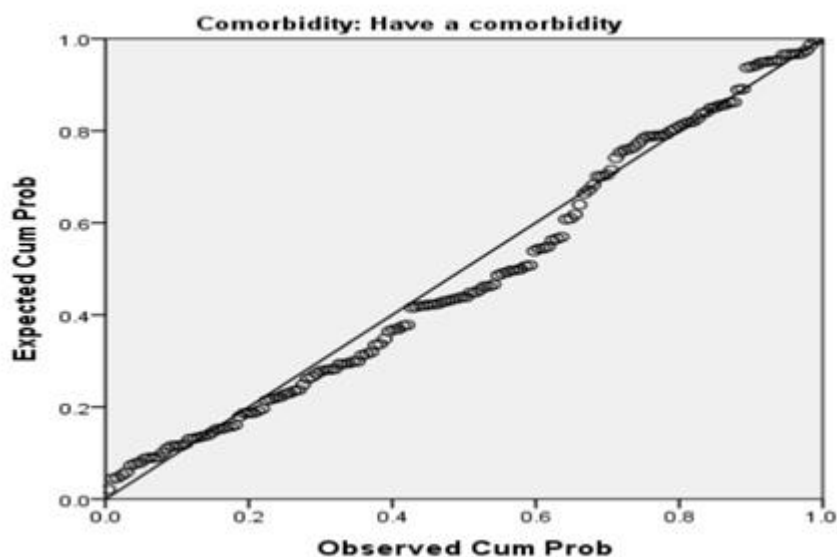


Figure (2): The distribution pattern of the BMI P-Plot among patients with comorbidities

IV. DISCUSSION

We did not find any significant association between BMI and thyroid function among our group of patients. Although these results contradict many studies conducted on this topic [3, 4, 5, 6, 7, 8, 17, 18], it agrees with others [5, 10, 11].

In this study, we performed a multiple linear regression analysis to investigate the relationship between BMI and thyroid function. Other studies compared the mean thyroid function test level among different weight groups using other statistical tests. We did not select patients with clinically significant thyroid derangement, but other studies did [3, 4, 5, 6].

The consensus in the literature is that BMI is positively correlated with TSH. The most widely accepted explanation is the “subclinical hypothyroidism theory”. In this theory, people who have a thyroid disorder, that did not yet reach the threshold to manifest clinically, may have a slightly abnormal BMI.

It is recommended that every laboratory determines its reference intervals, as such, thyroid function test normal range varies between laboratories. This can be due to variability in measurement techniques and preparation methods among other factors [19]. Our laboratory defines the normal TSH range as 0.3 – 3.5 mu/l. This is less than what is used in other studies. A study reported that subclinical hypothyroidism affects energy expenditure only when TSH level is clearly above the normal limit [3]. Using

a lower cut-off value to define a high TSH level might increase the sensitivity of the test while reducing its specificity. This can have an impact on the results of the linear regression analysis that we performed.

The mean BMI among our overweight patients was 32 Kg/m², while the mean of those with normal BMI was 22.5 Kg/m². Only 21 patients were morbidly obese (BMI> 39.9). Our group of patients was less obese on average than those in other studies. While there is conflict in the literature on the significance of higher BMI value on the effect on thyroid function, a more pronounced effect might be demonstrated in studies with higher average BMIs. Morbid obesity is associated with leptin resistance [2], a hormone that is associated with increased TSH level. Studies attribute this to its effect on TRH from the hypothalamus.

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