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Body Mass Index assessment among Hypothyroid patients and its response to Thyroxin Therapy

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ABSTRACT

Introduction: The most common endocrine disease in obesity is hypothyroidism and secondary endocrine alterations, including abnormal thyroid function, are frequent in obesity. The thyroid hormone (TH) controls dietary intake as well as energy expenditure, both resting and total, and consequently, obesity and different metabolic diseases can appear in patients with altered thyroid function. The most prevalent endocrine disease in obesity is subclinical primary hypothyroidism. It is suggested to test all patients with obesity for the presence of altered thyroid function.

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Hypothyroidism, defined as an increased circulating TSH value, affects up to 10% of the adults, affecting more women than men.

Methods: This is a prospective and observational study was conducted in the Department of Medicine at National Ribat University, University of khartoum, Alfad University for women, Sudan over a period of 2 year among 986 patients. Either gender patients above 18 years of age and obese were referred to the Department of Medicine for thyroid dysfunction evaluation. We excluded for the analysis patients with any variable that for any reason could influence on BMI: Hypocalorific diets, tobacco use, recent quit smoking or recreational drug use, severe psychiatric illness, pregnancy and postpartum stages, diabetes mellitus treated with insulin therapy, sulfonylureas, GLP-1 analogues or SGLT-2 inhibitors, prescription of drugs affecting body weight (corticosteroids, antipsychotics, mirtazapine, anticonvulsants, antineoplastic hormone therapy, fluoxetine or topiramate).

Result: The main clinical and laboratory data at baseline are reported in table 1. Mean TSH and fT4 were similar between obese and controls, while mean fT3 concentrations and mean BMI-SDS were significantly higher in the obese persons than in the control group.

Conclusion: In conclusion, hypothyroid and hyperthyroid patients after treatment and normalization of thyroid function have statistically significant changes in BMI, but these do not show great relevance in clinical practice because the BMI remained in the overweight range in both groups.
Keywords: obesity, endocrine abnormalities, bariatric surgery, hypothyroidism.

INTRODUCTION

The thyroid hormone (TH) controls dietary intake as well as energy expenditure, both resting and total, and consequently, obesity and different metabolic diseases can appear in patients with altered thyroid function. [1] Furthermore, altered thyroid function is characterized by the presence of changes in total body weight and total body composition, body temperature, and metabolic expenditure [2].

Thyroid function studies are frequently indicated in the evaluation of obesity etiology [3]. It is common to find slightly increased values of thyrotropin (TSH) in obesity [4]. It is unclear whether the altered thyroid function present in obesity is due to the excess adiposity or, alternatively, the decreased thyroid function is the cause of the excess adiposity. [5] The thyroid axis regulates the adipose tissue and the adipose tissue affects the activity of the thyroid axis [6].

Obesity could be considered a disease of the nervous system and is a great problem to the health system at the present time, with very important consequences for health care and society [7]. In recent years, the number of obese patients has progressively augmented. [8] In the last 40 years,

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obesity has reached epidemic proportions and obesity-related diseases have consistently increased in the last 30 years due, predominantly, to cardiovascular disease [9].

The most prevalent endocrine disease in obesity is subclinical primary hypothyroidism. It is suggested to test all patients with obesity for the presence of altered thyroid function [10]. Hypothyroidism, defined as an increased circulating TSH value, affects up to 10% of the adults, affecting more women than men [11]. Obesity is accompanied with endocrine alterations, including a decreased growth hormone (GH) response to different stimuli and altered thyroid function [12].

Thyroxine values have been found to be normal, increased, and decreased in obesity; these different results are likely due to the fact that the patients were examined at various time periods, have different sexes and ages, and may differ in the severity and kind of obesity as well as in the presence of obesity comorbidities [13]. The disturbance of thyroid function in obese patients and the role of BS treatment on thyroid function change is unclear at the present time. There are different studies showing various results in connection with the change of thyrotropin after BS and the influence of weight decrement [14]. The free thyroxine (FT4) results in obese patients and the influence of BS are even more controversial [15].

MATERIALS AND METHODS

This is a prospective and observational study was conducted in the Department of Medicine at National Ribat University, University of khartoum, Alfad University for women, Sudan over a period of 2 year among 986 patients.

Inclusion criteria

Either gender patients above 18 years of age and obese were referred to the Department of Medicine for thyroid dysfunction evaluation.

Exclusion criteria

We excluded for the analysis patients with any variable that for any reason could influence on BMI: Hypocalorific diets, tobacco use, recent quit smoking or recreational drug use, severe psychiatric illness, pregnancy and postpartum stages, diabetes mellitus treated with insulin therapy, sulfonylureas, GLP-1 analogues or SGLT-2 inhibitors, prescription of drugs affecting body weight (corticosteroids, antipsychotics, mirtazapine, anticonvulsants, antineoplastic hormone therapy, fluoxetine or topiramate) and other comorbidities such as advanced congestive heart failure, chronic obstructive pulmonary disease, end-stage renal disease or active neoplasm.

Anthropometric measurements

The height and body mass of the participants were measured using a stadiometer, in the absence of a coat and shoes. BMI was calculated as body mass (kg) divided by the square of height (m^2), and participants were categorized as underweight (BMI $< 18.5\ kg/m^2$), normal weight

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($18.5\ kg/m^2 \leq BMI < 23.9\ kg/m^2$), overweight ($24.0\ kg/m^2 \leq BMI < 27.9\ kg/m^2$), or obese (BMI $\geq 28\ kg/m^2$). Blood pressure was measured in the sitting position after 10 min of rest using an electronic sphygmomanometer.

Biochemical measurements

Blood samples were obtained after an overnight fast, and routine biochemical analyses (TSH, fT3, fT4, TC, TG, low-density lipoprotein-cholesterol [LDL-C], and HDL-C) were performed at accredited hospital laboratories.

Statistical analysis

Qualitative variables were described as numbers and percentages. A $\chi 2$-test was used to compare frequency of qualitative variables among the different groups. A Fisher's exact test was computed for 2x2 tables. Results were analyzed using the GraphPad Prism software version number 5. A result with $p < 0.05$ was considered statistically significant.

RESULTS

Table 1: Distribution of Age group of Case Group

Age groups (Year)	Number	Percentage	P-value
10-30	153	15.5	<0.0001
31-50	491	49.7	
51-70	342	34.6	
Total	986	100%	

In table 1, shows that the majority of patients were between [31-50] years (49.7%), also the age's frequency of patients at [51-70] years was (34.6%) and moreover, the table showed that the number of hypothyroid patients [10-30] years was (15.5%) only. The data analysis revealed a highly significant difference between the number of patients in the different age groups with (P<0. 0001).

Table 2: Distribution of gender of Case Group

Gender	Number	Percentage	P-value
Male	287	29.1	<0.0001
Female	699	70.9	
Total	986	100%	

All forms of thyroid disease were four to five times more common in females than in males in table 2.

Table 3: Characteristics of Case Group according to BMI

BMI (Kg/m^2)	Number	Percentage	P-value
<24.9	181	18.3	<0.0001
25-29.9	473	47.9	

>30	332	33.6	
Total	986	100%	

Table 4. Baseline anthropometric and clinical characteristics of the study group

Variable	Obese patients Mean±SD	Controls	P
Blood Glucose, mg/dl	90.8±9.3	82.1±8.08	<0.0005
Insulin, pmol/l	168.2±84.8	81.38±5.3	<0.0001
FT3, pmol/l	7.28±0.05	4.21±0.1	<0.0001
FT4, pmol/l	18.58±0.3	16.51±0.4	NS
TSH, mU/l	3.48±0.05	2.29±0.1	NS

The main clinical and laboratory data at baseline are reported in table 4. Mean TSH and fT4 were similar between obese and controls, while mean fT3 concentrations and mean BMI-SDS were significantly higher in the obese persons than in the control group. Abnormal concentrations of thyroid hormones were found in obese persons.

DISCUSSION

In our study, no statistically significant differences were observed in the weight or the BMI of hypo- and hyperthyroid patients, neither at diagnosis, nor following normalization of hormone levels after treatment. At baseline, both hypo- and hyperthyroid patient groups demonstrated a non-significant weight difference of approximately 6 kg, and a very similar BMI, respectively, with both groups falling into the overweight range. After treatment and normalization of thyroid function, the difference in weight between the two groups was further reduced. The BMI values also remained similar for both groups.

In addition, after analyzing the two different types of thyroid function disorder (hyper- and hypothyroidism) separately, we observed statistically significant differences between baseline and post-treatment body weight and BMI. Hypothyroid patients experienced a mean weight loss of 2.25±2.01 kg, which is much less than the weight loss described in classic series. [16] However, we are unaware of the existence of any recent series that had addressed this topic. Our results may have been influenced by the fact that seven of the hypothyroid patients showed a subclinical hormone alteration (TSH <10 μU/mL). However, it is noteworthy that patients with a greater degree of hypothyroidism (TSH 91.00 and 46.50 μU/mL) experienced a weight loss of less than 2 kg when they reached euthyroid status.

Some authors suggest that weight gain is greater in post-surgical hypothyroidism than in autoimmune hypothyroidism. [17] In our study, there was only one case of post-surgical

hypothyroidism; this might account for the non-significant weight loss experienced by these patients.

The relationship between hypothyroidism and obesity has historically been based on studies with a baseline population selected from obese patients whose thyroid hormone levels were assessed. In several of these studies, higher incidences of hypothyroidism were found in obese patients than in the general population. [18] Based on these findings, some authors have suggested that minor thyroid dysfunction might contribute to significant changes in body weight that could represent a risk factor for overweight and obesity. [19] However, these studies are inconclusive in establishing a cause–effect relationship, as the demonstration of a higher incidence of hypothyroidism in obese patients does not necessarily mean that the obesity is caused by the disorder. The relationship between hypothyroidism and obesity seems to be weaker than previously thought, even more in subjects with treated hypothyroidism.

In the hyperthyroidism patients group, weight gain was observed on completion of treatment when the results of the thyroid function test returned to normal. This is a common finding in the literature and there are several theories regarding it. Hyperthyroidism induces an increased basal energy expenditure that leads to weight loss as a result of a decrease in the body's lean and fat mass. When euthyroidism is regained, weight gain occurs at the expense of both compartments. [20] Another possible explanation for the tendency of hyperthyroid patients to gain weight after achieving euthyroidism could be related to an increase in post-treatment TSH levels over baseline levels. Hence, this would indicate the presence of relative hypothyroidism within the limits of analytic normality. [21] In our study, we were unable to test this hypothesis because of unavailability of patients' TSH levels prior to the onset of hyperthyroidism.

CONCLUSION

In conclusion, hypothyroid and hyperthyroid patients after treatment and normalization of thyroid function have statistically significant changes in BMI, but these do not show great relevance in clinical practice because the BMI remained in the overweight range in both groups.

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