Association of Thyroid-Stimulating Hormone Levels and Body Mass Index in Overweight Hispanics in Puerto Rico

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Introduction: Obesity is a serious public health problem, and the increasing prevalence of overweight status in the population is a major concern worldwide. Fifty eight percent of the Hispanic population of Puerto Rico is obese, but no data are available regarding thyroid status and body mass index (BMI) in this Hispanic group. This study was conducted to investigate if a relationship existed between obesity and thyroid function, as measured by thyroid-stimulating hormone (TSH) levels on a group of Hispanics enrolled in a weight control clinic in Puerto Rico.

Methods: We conducted a retrospective analysis of 637 clinical files of patients enrolled at Doctors Weight Loss Center. Five hundred seventy-five patients were eligible for this study. Inclusion criteria were adults ≥21 years of age with data for age, sex, height, weight, percentage fat, and TSH values.

Results: Prevalence of subclinical or mild hypothyroidism (TSH >4.1 mU/L), as per American Thyroid Association definitions, was 8.2% in our study group, which is higher than reported in the National Health and Nutrition Examination Survey (NHANES). Another 18.2% were in the at-risk category (TSH 2.51–4.0 mU/L).

Conclusion: We found no association between thyroid status and overweight or obesity in this study group but found a higher prevalence of subclinical hypothyroidism compared to the prevalence reported in NHANES. (*Ethn Dis*. 2008;18[Suppl 2]:S2-151–S2-154)

Key Words: Hypothyroidism, TSH, BMI, Hispanic

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Introduction

Nearly two thirds of adults in the United States are overweight, and 30.5% are obese, according to data from the 1999–2000 National Health and Nutrition Examination Survey (NHANES III) and the American Heart Association.[1] In Puerto Rico, according to statistics of Puerto Rico's health department published in May 2002, 58% of the citizens (2,208.994) are obese, the highest rate in a US territory.[2]

Researchers have studied the prevalence of hypothyroidism in obese patients.[3–5] In a sample of patients who suffered from sleep disordered breathing and were either obese or overweight, the prevalence of hypothyroidism was higher than was commonly reported for these patients.[6] In obese patients, evaluation of thyroid-stimulating hormone (TSH) levels may be useful to rule out possible impairment of resting energy expenditure due to reduced peripheral effect of thyroid hormones.[7]

An anecdotal and popular belief in Puerto Rico, among the overweight and obese, is that their weight gain is due to an underactive thyroid. However, to the best of our knowledge, no studies have examined whether a relationship exists between thyroid status and weight in this Hispanic population. The purpose of the present study was to investigate a possible association between TSH levels and overweight, characterized by body mass index (BMI), in Puerto Ricans.

Methods

Ethics

This study was presented to and approved by the institutional review board of the Medical Sciences Campus of the University of Puerto Rico. In addition, it was approved by Doctors Weight Loss Center clinic directors.

Data Collection

Our sample consisted of all patients enrolled at Doctors Weight Loss Center from January 1 through June 30, 2005. We included adults ≥21 years of age who had data for age, sex, height, weight, percentage fat, and TSH values. Of 637 records analyzed, 62 did not meet the inclusion criteria because they were <21 years of age. The final sample consisted of 575 patients.

Data Extraction

For each participant, we recorded TSH values, weight, height, age, percentage fat, and sex. BMI was calculated as weight in kilograms divided by height in meters squared, and patients were classified as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), or obese (≥30.0 kg/m^2).[8] Fat percentage was measured by Doctors Weight Loss Center personnel by using a BIA 310e Bioimpedance Analyzer (Biodynamics Corporation, Seattle, Wash).

Patient thyroid status was classified according to American Thyroid Association (ATA) guidelines as hyperthyroidism (.09–.39 mU/L), normal function (.4–2.5 mU/L), at risk of hypothyroidism (2.51–4.0 mU/L), subclinical or mild hypothyroidism (4.1–9.9 mU/L), or hypothyroidism (≥10.0 mU/L).[9]

Statistical Analysis

Normal distribution was evaluated by determination of skewness and kurtosis, and all variables were considered normally distributed. Prevalence of hypothyroidism was calculated by using

Table 1. Characteristics of patients enrolled at Doctors Weight Loss Center from January through June 2005, Puerto Rico (*N*=575)

Sex	*n*	%	Mean age (years)	Mean TSH (mU/L)	Mean BMI (kg/m^2)	Mean % Fat
Female	446	77.6	39.6	2.2	32.8	38.1
Male	129	22.4	40.1	1.9	35.9	31.4

TSH = thyroid-stimulating hormone, BMI = body mass index.

the ATA classification.[9] The relationship between serum TSH levels and BMI was examined by considering them to be continuous variables in a linear regression model ($Y=\beta_0+\beta_1X$). TSH levels were compared with BMI by using linear regression with age as a co-variable. All tests were two-sided, and differences were considered significant at $P<.05$. TSH levels and BMI were also examined as categorical variables by using an analysis of variance. Box plots of BMI values and TSH levels were used to show variability among groups. Statistical analyses were performed with SPSS version 11.5 (SPSS Inc., Chicago Ill).

RESULTS

Of the patients, 447 (77.6%) were women and 128 (22.4%) were men. Women were a mean of 39.6 years of age and men a mean of 40.1 years (Table 1). The mean TSH level was 2.2 mU/L for women and 1.9 mU/L for men. Mean BMI was 32.8 kg/m^2 for women and 35.9 kg/m^2 for men. Females had a mean fat percent of 38.1% and males had 31.4%.

When we analyzed our data for prevalence of hypothyroidism in our study group, we found that 26.4% had TSH values that characterized them either as hypothyroidism (8.2%) or at risk of hypothyroidism (18.2%); 71.5% of our sample had TSH values classified as normal, and 2.1% showed values characteristic of hyperthyroidism (Table 2). The mean TSH value for our study group was 2.1 mU/L (standard deviation 1.58 mU/L).

A statistically significant relationship ($P<.001$, $R^2=.042$) between BMI and TSH was found when we compared BMI and TSH as continuous variables in a linear regression model (Figure 1). In addition, when we examined the effect of age and BMI on TSH levels by using a multiple linear regression analysis, a statistically significant relationship was found ($R^2=.055$), which suggests that as age and BMI increased, TSH levels also increased (data not shown).

When participants were divided according to BMI category (normal, overweight, obese) and were compared to TSH level as a categorical variable, we did not find a significant relationship ($P=.08$) among the three groups (Figure 2). Nevertheless, as BMI increased, the dispersion of TSH values increased in the group of obese subjects, indicating that TSH values in this group were more variable than in patients (33) with normal BMI

Table 2. Classification of 575 patients enrolled at Doctors Weight Loss Center according to American Thyroid Association thyroid function categories

Category	Frequency	Valid %
Hyperthyroid	12	2.1
Normal	411	71.5
At Risk for hypothyroid	105	18.2
Hypothyroid	47	8.2
Total	575	100.0

DISCUSSION

We found an 8.2% prevalence of hypothyroidism in our sample, which is double the prevalence reported in Hispanic groups (4.1%) in NHANES III.[1] Several factors may explain this higher prevalence in our sample. NHANES III describes the general population, while our sample was mainly overweight or obese. In addition, the Hispanic population in NHANES III is mainly Mexican American and therefore does not necessarily reflect other Hispanic groups, such as Puerto Ricans. Furthermore, in our study our threshold level for mild hypothyroidism was 4.1 mU/L as classified by ATA, while NHANES III used 4.5 mU/L as a cutoff.

Other researchers have studied the influence of thyroid problems on BMI. Manji et al[4] found no association between serum concentrations of TSH and free thyroxine concentrations within the normal range and BMI. In contrast, Knudsen et al[10] found that thyroid function could be one of several factors that act in concert to determine body weight.

In this study we found serum TSH to be significantly associated with BMI. Higher and more variable TSH levels were found in the obese category. Since adiposity has been linked to hypothyroidism (clinical or subclinical),[11] obese patients should be assessed for a deficit of resting energy expenditure and levels of thyroxine, which in conjunction are a better measure of thyroid hormone activity at the tissue level[7] and could explain the variability in TSH.

Our results have to be interpreted within the limitations of this pilot

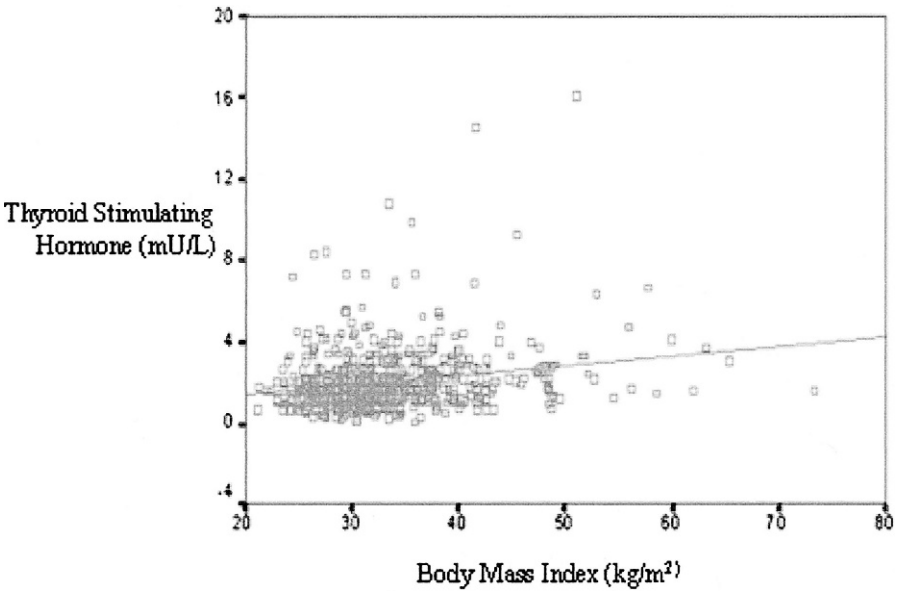

Fig 1. A statistically significant relationship (P<.001, R^2=.042) between body mass index and thyroid-stimulating hormone when compared as continuous variables. Variations in BMI implied changes in TSH.

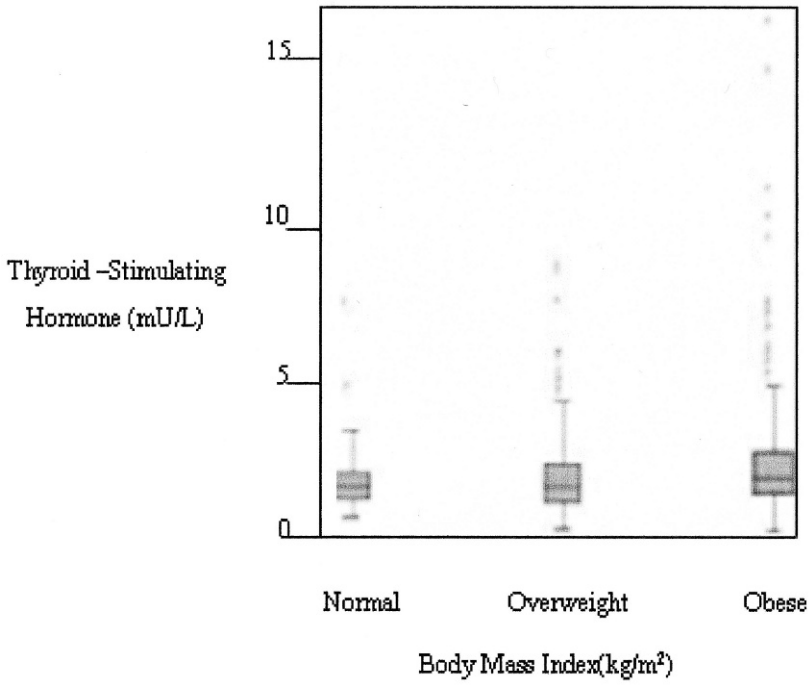

Fig 2. Participants were divided according to body mass index (BMI) category and were compared to thyroid-stimulating hormone (TSH) level as a categorical variable by using an analysis of variance. No significant difference was observed among the three groups (P=.08), although TSH values were more dispersed in the group of obese patients, which may indicate more variability of TSH values than in patients with normal BMI.

study. We are aware that thyroid function was assessed only through TSH levels. As our R^2 values suggest, other causal mechanisms may not be accounted for, such as the variability in TSH reporting in patient records. A follow-up study should include normal-weight and overweight patients. In this new cohort, thyroid function should be assessed by TSH and free thyroxine.[12]

Huestan et al[13] found high triglyceride and low high-density lipoprotein cholesterol levels in a sample of patients with subclinical hypothyroidism. We did not asses the hyperlipidemic status of our patients, although this is a study that should be done.

In conclusion, our data show that 91.8% of overweight patients had normal TSH levels. In this group of overweight persons, thyroid status does not appear to be the predominant causal variable. Other variables like diet, metabolic syndrome, or diabetes and lifestyle must be studied.

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