Research Article

Interrelationship of serum TSH with BMI in patients with thyroid disorders

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Abstract

Introduction: The endocrine system is evaluated primarily by measuring hormone concentrations, thereby arming the clinician with valuable diagnostic information. Thyroid Hormones which increase the basal metabolic rate and thermogenesis have been reported to be one of leptins regulating factors because alterations of thyroid status might lead to compensatory changes in circulatory leptin. **Aim**: The aim of this study was to find the correlation of Serum TSH with BMI in patients with thyroid disorder (hypothyroidism and hyperthyroidism). **Material & Methods**: 30 diagnosed cases of thyroid disorders out of which 20 were of hypothyroidism and 10 were of hyperthyroidism and 30 healthy controls were recruited in our study. Serum TSH levels were estimated in both cases and controls using ELISA method. BMI was calculated using QUETLET'S index as body weight (kg) divided by height squared (m^2). **Results**: In our study we found a significant (p=<0.001) positive correlation (r=0.514) of TSH with BMI in hypothyroid patients whereas a non significant (p=.551) positive correlation (r=.215) was found in hyperthyroid patients. **Conclusion**: Even small changes in the TSH levels can have an effect on BMI profile. In hypothyroid patients there is increase in weight so increase in BMI and also increase in TSH. On the other hand in hyperthyroid individuals there is loss of weight so decrease in BMI and also decrease in TSH. But further large scale data is required to confirm our findings.

Keywords: BMI-Body mass index, hyperthyroid, hypothyroid, TSH-thyroid stimulating hormone.

Introduction

The thyroid gland produces two related hormones, thyroxine (T_4) and triidothyronine (T_3). Acting through nuclear receptors, these hormones play a critical role in cell differentiation during development and help maintain thermogenic and metabolic homeostasis in the adult [1]. The BMI is an attempt to quantify the amount of tissue mass(muscle, fat and bone) in an individual, and then categorize that person as underweight, normal weight, overweight, or obese based on that value [2]. Among Asian adults, a BMI value of ≥23.0 is considered as obese, as per WHO experts [3].

Overt thyroid dysfunction affects body weight. Clinical hypothyroidism causes an increase in body weight, while hyperthyroidism reduces it .Moreover, the disorders of the thyroid function may be primary, and the BMI changes may be secondary or vice versa. During a progressive impairment of thyroid function, the levels of TSH and thyroid hormones change until clinical hypothyroidism is presented [4]. The correlation between TSH and BMI could be mediated by leptin produced by adipose tissue [5, 6]. In subclinical hypothyroidism, for example, altered thyroid function with normal feedback regulation (FT_4 at the lower limit of normal range and increased TSH albeit within normal range) may be the primary event that induces alterations in energy expenditure with subsequent increase in BMI and weight [7, 8]. Both subclinical and overt hypothyroidism are frequently associated with weight gain, decreased thermogenesis and metabolic rate [9, 10]. The mild thyroid dysfunction is linked to significant changes in body weight and likely represents a risk factor for overweight and obesity [11].

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Aim of the study

To study the correlation of serum thyroid stimulating hormone with body mass index in patients of thyroid disorders.

Materials and Methods

The present study was conducted in Department of Biochemistry at Govt. Medical College, Patiala on 30 diagnosed cases of thyroid disorder (out of which 20 were of hypothyroidism and 10 were of hyperthyroidism) referred by Department of Medicine, Rajindra Hospital, Patiala from October, 2011 to May, 2012. For comparison 30 age and gender matched healthy individuals constituted the control group. Patients with history of any drug intake, history of any infection/illness, pregnant females, diabetic patients, cancer including thyroid cancer were excluded from the study. Informed consent of all subjects and detailed history were taken at the beginning of the study. Fasting venous blood samples were collected under all aseptic conditions, and subsequently, Serum TSH levels were estimated in both cases and controls by ELISA method using ERBA Thyrokit [12]. Weight (kg) and height (m) was measured while the subjects were barefoot and wearing light clothes. Further, BODY MASS INDEX (BMI) was calculated using Quetlet's Index [13].

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

Statistical Analysis: Statistical analysis was performed using Statistical Package for Social Sciences (SPSS). Means and Standard Deviations (SD) were calculated for all parameters. The independent sample *t*-test was used to compare the means of different variables in the two groups. In addition, the Pearson correlation coefficient (*r*) was used for correlation analysis. P value <0.05 was considered significant.

Results

The mean age in the present study was 42.2±15.30 years. Out of 30 patients there were 24 females and 6 male patients. The patients had duration of illness between 6 months to 4 years. Serum TSH (Table II) and BMI (Table I) was measured in both study and control group. In our study we found a significant (p=<0.001) positive correlation (r=0.514) of TSH with BMI in hypothyroid patients whereas a non significant (p=.551) but positive correlation (r=.215) was found in hyperthyroid patients (Table III).

Table I: Comparison of Body Mass Index in Cases and Controls.

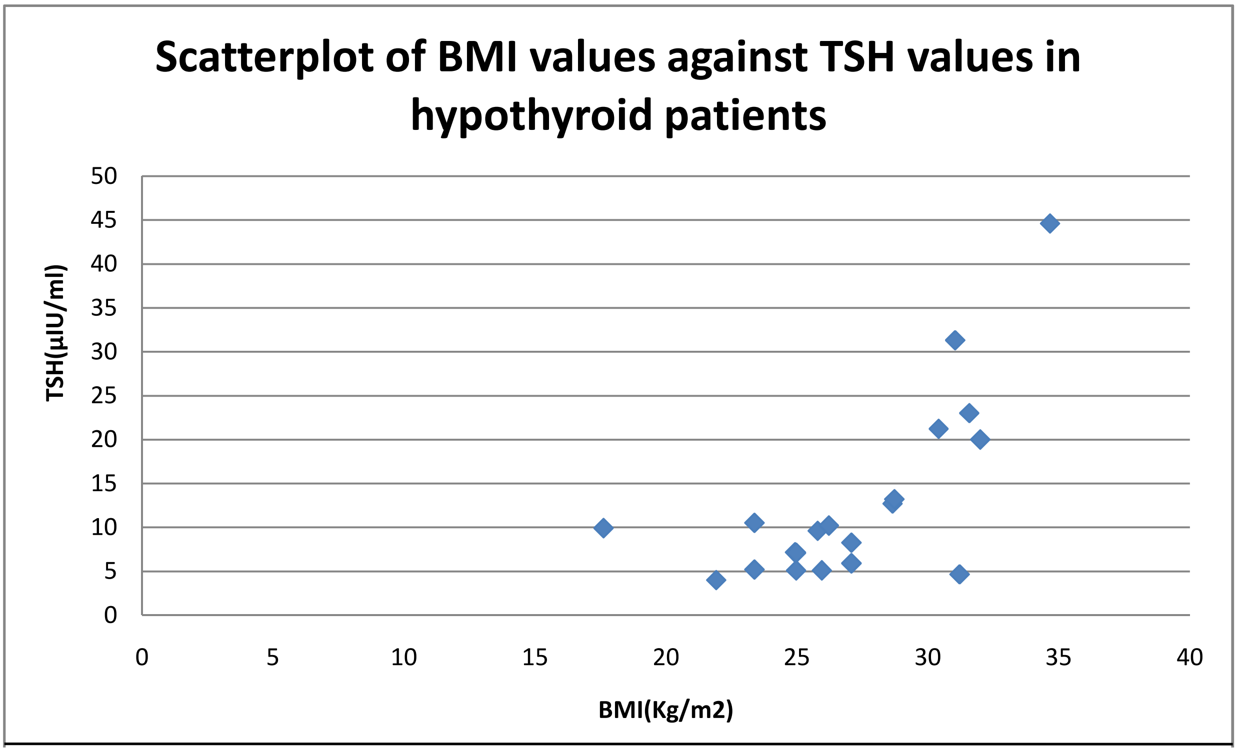
Parameter	Group	No. of patients	Range	Mean ±SD
BMI (kg/m^2)	Hypothyroid	20	17.62-32.0	27.07±4.04
	Hyperthyroid	10	17.36-27.75	19.61±3.53
	Control	30	17.9-32.0	23.58±3.68

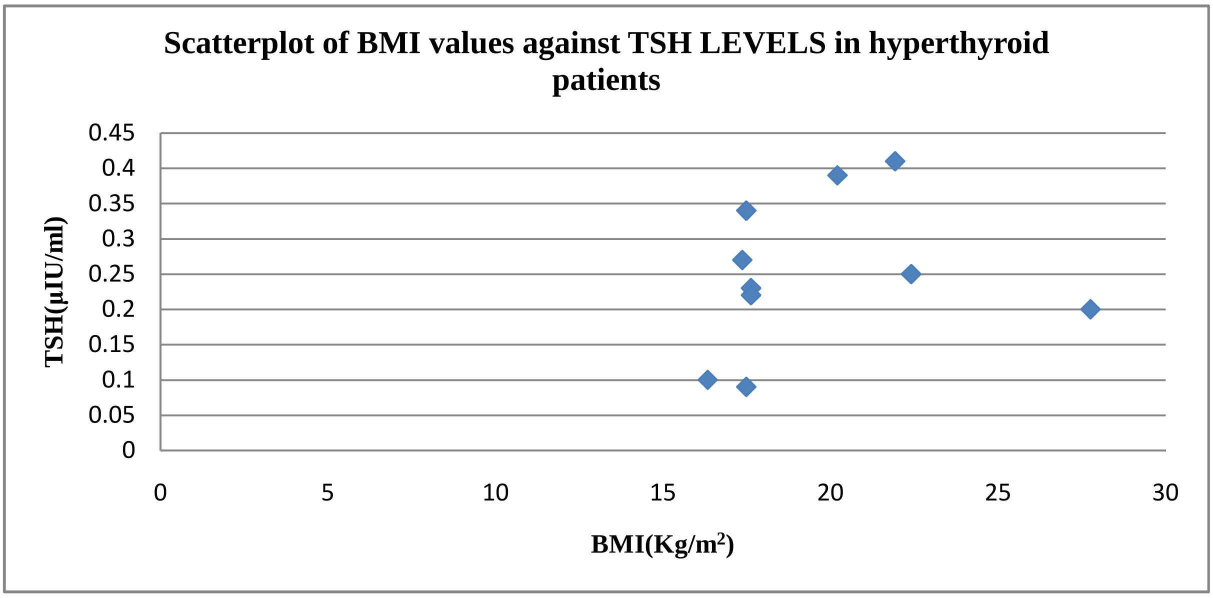
Table II: Comparison of Thyroid Stimulating Hormone (TSH) in Cases and Controls.

Parameter	Group	No. of patients	Range	Mean ±SD
TSH (µIU/ml)	Hypothyroid	20	3.99-44.6	12.93±10.42
	Hyperthyroid	10	0.09-0.41	0.25±0.10
	Control	30	0.6-4.2	2.83±1.04

Table-III: Correlation of BMI and TSH in Cases and Controls.

Correlation	Group	r	P	Significance
Serum TSH and BMI	Hypothyroid	0.693	0.001	S
	Hyperthyroid	0.215	0.551	NS
	Control	0.232	0.217	NS





Discussion

Mean age for the study group was 42.2±15.30 years and for control group was 36.07±14.24 years. There was no significant difference in the mean age of patients among the two groups. Yoshida et al (1998) observed the mean age of 38.4±1.8 years in his study [14]. Tene Perez et al (2004) found the mean age of 35 years in his study [15]. In this study there were 24 females and 6 males and male: female ratio was 1:4. Zimmermann Belsing et al (1998) had a similar type of sex distribution among his patients i.e. 2 males and 8 females [16].

In this study we found a significant (p=<0.001) positive correlation(r=0.514) of TSH with BMI in hypothyroid patients whereas a non significant (p=.551) but positive correlation (r=.215) was found in hyperthyroid patients. Solanki et al reported that the level of TSH is quite higher in obese patients and it increases as BMI increases [17]. Velivela et al supported this study that the prevelance of subclinical hypothyroidism is higher in females and increased with BMI [18]. Milionis and Milionis reported that thyroid disorder associated with the influence of various environmental factors can increase body weight and leads to obesity [4]. Azza M. Abdu-Allah et al studied the patients with thyroid dysfunction. BMI was calculated. A higher BMI was found in the hypothyroid group compared with the hyperthyroid group [19]. Nagila et al studied the correlation between serum TSH level and lipid profile in patients of varying degrees of obesity depending on the body mass index (BMI). As the lipid profile is deranged with higher BMI, it imparts resistant to TSH in peripheral tissue further aggravating the thyroid problem [3]. Iacobellis et al evaluated thyroid function and its possible relationship with body mass index (BMI), TSH and BMI were positively related [20]. Pinkney et al investigated the relationships of TSH in 18 patients with newly diagnosed hyperthyroidism, 22 patients with newly diagnosed primary hypothyroidism, and 32 lean (body mass index [BMI] < 30 kg/m^2) and 37 obese (BMI > 30kg/m^2) euthyroid subjects. BMI did not change significantly in the hypothyroid subjects [21].

The causal relationship between BMI and variations in thyroid function could be explained by the process of thermogenesis. Thyroid hormones increase thermogenesis through an increase in increase in cellular activity to produce ATP [22].

Conclusion

From our study it is concluded that variations in thyroid functions are associated with differences in BMI. This may be due to changes in resting energy consumption. The high incidence of the pathological disorders in thyroid function combined with strong influence of various environmental factors can increase weight and may lead to obesity. But large scale studies are definitely required to confirm the relationship of the two parameters.

Abbreviations

ATP-Adenosine Triphosphate, BMI - Body Mass Index, ELISA - Enzyme Linked Immunosorbent Assay, NS-Non Significant, TSH - Thyroid Stimulating Hormone, WHO -World Health Organization.

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References

1. Longo DL, Kasper DL, Jameson JL, Fauci AS, Hauser SL, Loscalzo J. Disorders of the Thyroid Gland. In: Harrison's Principles of Internal Medicine. McGraw-Hill 2012; 18:2911-25.

2. Dr Malcolm Kendrick (April 12, 2015).”Why being’ overweight’ means you live longer: The way scientists twist the facts” (http:/www. independent.co.uk/life-style/ health-and-families / features / why-being-overweight means-you-live-longer-the-way-scientists-twist - the-facts -10158229.html)

3. http: /www. independent. co. uk. Retrieved 12 April 2015.

4. Nagila A, Bhatt M, Poudel B, Mahato P, Gurung D, Prajapati S et al. Thyroid Stimulating Hormone and its Correlation with Lipid Profile in the Obese Nepalese Population. Journal of Clinical and Diagnostic Research. 2008; (2):932-937.

5. Milionis A, Milionis C. Correlation between body mass index and thyroid function in euthyroid individuals in Greece. ISRN Biomark. 2013; 2013:651494.

6. Feldt-Rasmussen U. Thyroid and leptin. Thyroid. 2007; 17(5):413-419.

7. Menendez C, Baldelli R, Camiña JP, Escudero B, Peino R, Dieguez C et al. TSH stimulates Leptin secretion by a direct effect on Adipocytes. J Endocrinol. 2003; 176(1):7-12.

8. Knudsen N, Laurberg P, Rasmussen LB, Bülow I, Perrild H, Ovesen L et al. Small differences in thyroid function may be important for body mass index and the occurrence of obesity in the population. J Clin Endocrinol Metab. 2005; 90(7):4019-4024.

9. Reinehr T. Obesity and thyroid function. Mol Cell Endocrinol. 2010; 316:165-171.

10. Hoogwerf BJ and Nuttall FQ. Long-term weight regulation in treated hyperthyroid and hypothyroid subjects. Am J Med. 1984; 76(6):963-70.

11. Asvold BO, Bjøro T, Vatten LJ. Association of serum TSH with high body mass differs between smokers and never-smokers. J Clin Endocrinol Metab. 2009; 94(12):5023-5027.

12. Al-Adsani H, Hoffer LJ, Silva JE. Resting energy expenditure is sensitive to small dose changes in patients on chronic thyroid hormone replacement. J Clin Endocrinol Metab. 1997; 82(4):1118-1125.

13. Spencer CA, Takeuchi M, Kazarosyan M, MacKenzie F, Beckett GJ, Wilkinson E. Interlaboratory/intermethod differences in functional sensitivity of immunometric assays of thyrotropin (TSH) and impact on reliability of measurement of subnormal concentrations of TSH. Clin Chem. 1995; 41:367-374.

14. Body Mass Index: Considerations for Practitioners. Department of Health and Human Services Centers for disease control and prevention. Available at: http: // www. cdc. Gov / obesity / downloads / BMI for Pactitioners. pdf.

15. Yoshida T, Momotani N, Hayashi M, Monkawa T, Ito K, Saruta T. Serum leptin concentrations in patients with thyroid disorders. Clin Endocrinol (Oxf). 1998; 48(3):299-302.

16. Tene Pérez CE, Revilla-Monsalve MC, Amato D, Escobedo de la Peña J, Galván R, Millán-Guerrero RO. Correlation between serum leptin levels and insulin sensitivity in diffuse toxic goiter. Endocr Res. 2004; 30(1):19-27.

17. Zimmermann-Belsing T, Brabant G, Holst JJ, Feldt-Rasmussen U. Circulating leptin and thyroid dysfunction. Eur J Endocrinol. 2003; 149(4):257-71.

18. Solanki A, Bansal S, Jindal S, Saxena V, Shukla US. Relationship of serum thyroid stimulating hormone with body mass index in healthy adults. Indian J Endocrinol Metab. 2013; 17 Suppl 1:S167-9.

19. Velivala AP, Paladugu L, Koyyala VP. Subclinical hypothyroidism in obese patients in rural general hospital. IOSR J Dent Med Sci. 2013; 5(4):8-10.

20. Azza M. Abdu-Allah, Riham G. Mahfouz, Seham A. Khodeer, Walid A. Shehab-Eldin, Mostafa El Nagar. Study of Resistin and Leptin in patients with Thyroid Dysfunction. Journal of American Science, 2011; 7(3):569-76.

21. Iacobellis G, Ribaudo MC, Zappaterreno A, Iannucci CV, Leonetti F. Relationship of thyroid function with body mass index, leptin, insulin sensitivity and adiponectin in euthyroid obese women. Clin Endocrinol (Oxf). 2005; 62(4):487-91.

22. Pinkney JH, Goodrick SJ, Katz J, Johnson AB, Lightman SL, Coppack SW et al. Leptin and the pituitary-thyroid axis: a comparative study in lean, obese, hypothyroid and hyperthyroid subjects. Clin Endocrinol (Oxf). 1998; 49(5):583-8.

23. Sestoft L. Metabolic aspects of the calorigenic effect of thyroid hormone in mammals. Clin Endocrinol. 1980; 13 (5): 489-506.

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