

## Original Research

### Assessment of relationship between thyroid function and body mass index in adolescent girls

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#### ABSTRACT:

**Background:** The relationship between thyroid function and body weight in euthyroid individuals has been given a great medical concern. The present study was conducted to assess relationship between thyroid function and body mass index in adolescent girls. **Materials & Methods:** 120 adolescent girls were included. Measurement of weight, height and body mass index (BMI) was calculated by the formula  $BMI = \text{weight in kg}/\text{height}^2$  in meter. Group I were having calculated BMI within this range. Group II had BMI below 25 and above 75 percentile were referred to as abnormal BMI. Thyroid-stimulating hormone and total T4 were estimated. **Results:** The mean age was 15.4 years, weight was 49.2 Kgs, height was 150.2 cm, BMI was 20.3 g/m<sup>2</sup>, TSH level was 2.62  $\mu\text{IU/mL}$  and total T4 level was 10.4 ng/dL. The mean age was 14.2 years in group I and 16.5 years in group II. weight was 47.5 kgs in group I and 65.2 kg in group II, weight (cm) was 154.6 cm in group I and 167.2 cm in group II, BMI was 18 kg/m<sup>2</sup> in group I and 23.4 kg/m<sup>2</sup>, TSH ( $\mu\text{IU/mL}$ ) was 2.4 in group I and 3.7 in group II and total T4 (ng/dL) was 10.2 in group I and 9.4 in group II. The difference was significant ( $P < 0.05$ ). **Conclusion:** There was positive correlation of TSH with BMI.

**Key words:** Adolescent, Obesity, Thyroid

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#### INTRODUCTION

Obesity is associated with several unfavorable outcomes including diabetes mellitus, cardiovascular disease, kidney disease, cancer, and all-cause mortality. Obesity has more than doubled worldwide since 1980.<sup>1</sup> It is believed that understanding the pathogenesis of obesity could help to prevent progression of this pandemic. The relationship between thyroid function and body weight in euthyroid individuals has been given a great medical concern. Various researchers have studied the effect of the thyroid hormones on body mass index (BMI), and it has been demonstrated that overt thyroid dysfunction affects body weight.<sup>2</sup> Clinical hypothyroidism causes an increase in body weight, while hyperthyroidism reduces it. However, variations in thyroid function exist also between individuals with thyroid hormones' levels within the reference (physiologic) range.<sup>3</sup> These slight differences within

the normal thyroid function may have important implications for the regulation of body weight and thus the prevalence of obesity. Although the optimal values for thyrotropin (TSH), T4 and T3 are not firmly established.<sup>4</sup>

The adolescent period is an important stage of development. Thyroid hormones have a major role during this stage. Thyroid hormones are essential for normal growth, sexual development, and reproductive function.<sup>5</sup> During puberty, changes in thyroid functions and an increase in thyroid volume occur as an adaptation to physical development and reproductive maturation. Any small derangement in thyroid hormone profile during this period will affect the individual's overall growth, especially BMI.<sup>6</sup> The present study was conducted to assess relationship between thyroid function and body mass index in adolescent girls.

**MATERIALS & METHODS**

The present study comprised of 120 adolescent girls. The written consent was obtained from all subjects. A detailed personal history was obtained. A complete clinical examination, and laboratory investigations was carried out. Physical examination was conducted such as measurement of height by a stadiometer without shoes. The weight of was measured by a digital weighing machine. Body mass index (BMI) was calculated by the formula BMI = weight in kg/height<sup>2</sup> in meter. Body mass index in the range of 25 to 75 percentiles according to the Indian Association of Paediatrics (IAP) was defined as normal BMI.

We classified subjects into groups based on BMI. Group I were having calculated BMI within this range. Group II had BMI below 25 and above 75 percentile were referred to as abnormal BMI. Thyroid-stimulating hormone and total T4 were estimated by Cobas e411 based on electrochemiluminescence assay (ECLIA). The biological reference range for serum TSH and T4, according to kit inserts, was considered to be 0.51–4.3 (μIU/mL) and 0.76–1.7 (ng/dL), respectively. Results were statistically assessed using Mann Whitney U test. P value less than 0.05 was considered significant.

**RESULTS**

**Table I Demographic data**

Parameters	Number
Age (years)	15.4
Weight (Kgs)	49.2
Height (cm)	150.6
BMI (Kg/m <sup>2</sup> )	20.3
TSH (μIU/mL)	2.62
Total T4 (ng/dL)	10.4

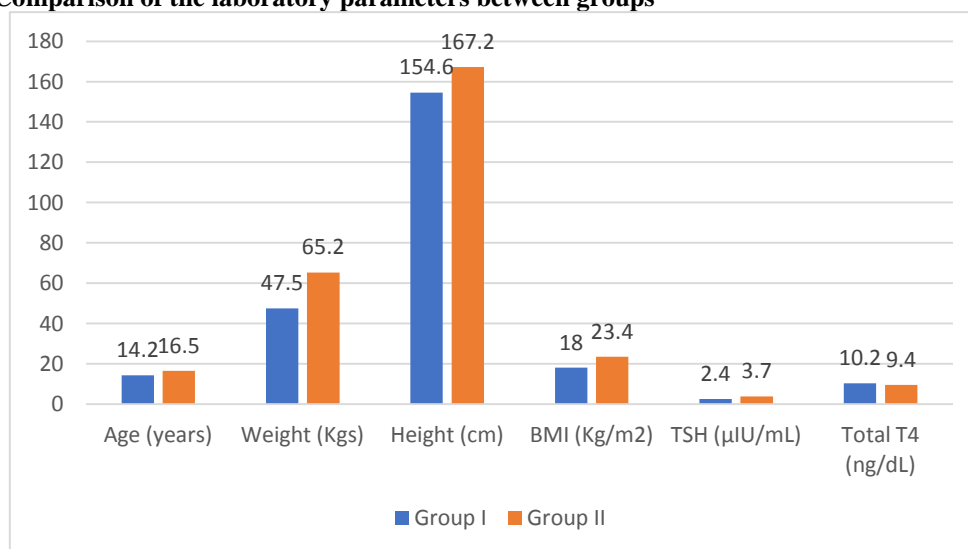
Table I shows that mean age was 15.4 years, weight was 49.2 Kgs, height was 150.2 cm, BMI was 20.3 g/m<sup>2</sup>, TSH level was 2.62 μIU/mL and total T4 level was 10.4 ng/dL.

**Table II Comparison of the laboratory parameters between groups**

Parameters	Group I	Group II	P value
Age (years)	14.2	16.5	0.81
Weight (Kgs)	47.5	65.2	0.04
Height (cm)	154.6	167.2	0.05
BMI (Kg/m <sup>2</sup> )	18	23.4	0.01
TSH (μIU/mL)	2.4	3.7	0.01
Total T4 (ng/dL)	10.2	9.4	0.09

Table II, graph I shows that mean age was 14.2 years in group I and 16.5 years in group II. weight was 47.5 kgs in group I and 65.2 kg in group II, weight (cm) was 154.6 cm in group I and 167.2 cm in group II, BMI was 18 kg/m<sup>2</sup> in group I and 23.4 kg/m<sup>2</sup>, TSH (μIU/mL) was 2.4 in group I and 3.7 in group II and total T4 (ng/dL) was 10.2 in group I and 9.4 in group II. The difference was significant (P< 0.05).

**Graph I Comparison of the laboratory parameters between groups**



**Table III Correlation of BMI with thyroid hormone**

Parameters	r	P value
T3	0.21	0.54
T4	0.32	0.06
TSH	0.65	0.01

Table III shows that there was positive correlation of TSH with BMI.

## DISCUSSION

The thyroid gland plays a crucial role in the control of energy metabolism through thyroid hormone actions. Triiodothyronine (T3) plays a critical role in regulation of energy metabolism and thermogenesis and also in glucose and lipid metabolism.<sup>7</sup> On the other hand, obesity per se has several effects on the hypothalamic-pituitary-thyroid axis.<sup>8</sup> Thus, an intriguing cycle between obesity and thyroid could be conceived. Many studies have investigated the association between thyroid function and anthropometric measures.<sup>9</sup> Despite the conflicting data available, several cross-sectional studies have shown a significant positive association between body mass index (BMI) and serum thyrotropin (TSH), even for reference range values.<sup>10</sup> Also there are controversial data regarding association between BMI and serum free thyroid hormones, most documenting negative association.<sup>11</sup> The present study was conducted to assess relationship between thyroid function and body mass index in adolescent girls.

In present study, there were 120 adolescent girls. We found that mean age was 15.4 years, weight was 49.2 Kgs, height was 150.2 cm, BMI was 20.3 g/m<sup>2</sup>, TSH level was 2.62  $\mu$ IU/mL and total T4 level was 10.4 ng/dL. Eftekhari et al<sup>12</sup> examined the relationship between thyroid function and body mass index. 227 high school participants (aged 12-21) were selected. Serum samples were collected and assayed for Triiodothyronine (T3), thyroxine (T4), thyroid stimulating hormone (TSH), reverse triiodothyronine (rT3), free thyroxine (FT4), free triiodothyronine (FT3). Weight and height were measured and body mass index (BMI) were calculated (weight (kg)/height<sup>2</sup> (m)). Subgroup analysis was done according to body mass index. TSH, T4 and rT3 were correlated with BMI ( $r = 0.66$ ,  $p = 0.001$  and  $r = 0.12$ ,  $p = 0.05$  and  $r = 0.65$ ,  $p = 0.001$ , respectively). Adolescent girls with BMI  $\geq 25$  kg m<sup>-2</sup> showed higher serum TSH, T4 and rT3 than subjects with BMI  $< 25$  kg m<sup>-2</sup> ( $p = 0.001$ ,  $p = 0.05$  and  $p = 0.001$ , respectively). Present results showed that, although thyroid function was normal in the studied participants TSH and rT3 were positively correlated to BMI. TSH and rT3 could present a marker of altered energy balance in overweight and obese adolescent girls.

We found that mean age was 14.2 years in group I and 16.5 years in group II. weight was 47.5 kgs in group I and 65.2 kg in group II, weight (cm) was 154.6 cm in group I and 167.2 cm in group II, BMI was 18 kg/m<sup>2</sup> in group I and 23.4 kg/m<sup>2</sup>, TSH ( $\mu$ IU/mL) was 2.4 in group I and 3.7 in group II and total T4 (ng/dL) was

10.2 in group I and 9.4 in group II. Priya et al<sup>13</sup> analyzed the association between BMI and thyroid function in adolescent girls. Seventy-five girls of 12–18 years of age group were included in this study. The median values of age, weight, and TSH levels were significantly higher in group II participants when compared with group I. In group II, serum TSH and BMI depicted a highly significant positive correlation ( $p$  value = 0.001) while in group I this correlation was 0.044. Conclusion: Serum TSH was found elevated in participants with BMI derangement. The stronger correlation between TSH and BMI suggested regarding the inter-relationship between thyroid hormone and BMI and impact of each other's metabolism.

Abdi et al<sup>14</sup> evaluated the association between change in thyroid function tests within the euthyroid range and body mass index (BMI) in persons with normal weight at baseline. A total of 569 women and 531 men, aged  $36.3 \pm 13.5$  years, were included. Modified Poisson regression analysis for binary outcome, after adjustment for age, sex, smoking, and anti-thyroid peroxidase antibody status, revealed a negative association between delta serum FT4 and follow-up BMI without any significant association between change in serum TSH and follow-up BMI. However, in multinomial logistic regression analysis, we found no relationship between delta serum FT4 or TSH and follow-up BMI categories, for either overweight or obese vs. normal-weight participants.

## CONCLUSION

Authors found that there was positive correlation of TSH with BMI.

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