

Correlation of T3, T4 and TSH Levels with Diastolic Blood Pressure in Premenopausal Women with Altered Thyroid Hormone Status

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Abstract:

Introduction: Hypothyroid or Hyperthyroid state affects all the physiological systems including the cardiovascular system. Among all adverse changes, diastolic blood pressure can also be affected in patients with thyroid disorders.

Objectives: The present study was carried out to find out correlation of T3, T4 and TSH levels with diastolic blood pressure in premenopausal women with altered thyroid hormone status

Materials and Methods: The present study was carried out in 90 female subjects in the age group of 30 to 45. Diagnosis of hypothyroidism and hyperthyroidism was based on both clinical and biochemical criteria. Subjects were divided in euthyroid, hypothyroid and hyperthyroid groups with each group containing 30 subjects. Resting diastolic blood pressure was measured in all the groups.

Results: A negative linear correlation of total T3 and total T4 hormone level with resting diastolic blood pressure ($p < 0.001$) was observed. A positive linear correlation of total TSH hormone level with resting diastolic blood pressure ($p < 0.001$) was noted.

Conclusion: Thyroid hormone directly or indirectly decreases peripheral resistance by dilating the arterioles. As T3 and T4 levels increase and as TSH levels decrease, resting diastolic blood pressure goes on decreasing linearly. On the other hand, as T3 and T4 levels decrease and as TSH levels increase, resting diastolic blood pressure goes on increasing linearly. Hence thyroid hormone concentration should be kept within normal limits by appropriate therapeutic measures so as to prevent ill effects of resultant deranged diastolic blood pressure.

Keywords: Diastolic blood pressure, T3, T4, TSH.

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Introduction

Recently there has been increased prevalence of Thyroid disorder among various endocrinopathies. [1] There is a Global burden of 2 billion cases of thyroid disorders, with more than 40 million in India. [2] Hypothyroid or hyperthyroid state affects various physiological systems including cardiovascular system, central nervous system, digestive system, blood, etc. Among these systems, cardiovascular system is affected profoundly. The changes in the cardiovascular system due to alteration in thyroid hormones are not only due to changes in heart functions and vascular functions, but also believed to be due to altered autonomic regulation of cardiovascular system. [3] Various Tests for autonomic functions like Ewing's

autonomic function tests which comprises tests for heart rate and blood pressure changes are popular. [4] With this background the present study was carried out to test the hypothesis that change in thyroid status of a subject can affect resting diastolic blood pressure. An attempt was made to assess the correlation of T3, T4 and TSH with diastolic blood pressure in premenopausal women with altered thyroid hormone status.

Material and Methods:

The present study was conducted in department of physiology of a government medical college in a urban city after obtaining consent from the institutional ethics committee. Total of 90 female

subjects were selected from the patients attending medicine OPD of a tertiary health care centre and their age matched relatives.

Non-Pregnant females in the age group of 30-45 years with no past history of any thyroid disorders and/or taking treatment for thyroid disorder in the past or present and who were not suffering from any other major illness were included in the present study.

Subjects with history of any other cause of endogenous or exogenous obesity, subjects with diabetes mellitus, hypertension or ischemic heart disease, postmenopausal females, alcoholics and smokers were excluded from the present study.

All the participants were explained verbally in detail about the purpose and every step in the study and a written consent was obtained from all the

participants. The detailed medical history was taken and clinical examination was done.

Diagnosis of hypothyroidism and hyperthyroidism was based on both clinical and biochemical criteria. Clinical diagnosis was done by a physician in the OPD of Medicine department.

Biochemical diagnosis was based on total concentration of T3 (Tri-iodothyronine), T4 (Thyroxine) and TSH (Thyroid Stimulating Hormone) in plasma. All the participants were asked to come in the morning at 8 am. They were asked to observe overnight fast before coming for this test. 5ml fasting blood sample was obtained under all aseptic precautions. Serum was separated and serum total T3, T4 and TSH was estimated by using Enzyme linked immunosorbent assay (ELISA) method.

Table 1: Thyroid Hormone profile, Laboratory reference range by ELISA test

Tests (Parameters)	Expected normal Value
Total T3	56 to 188 ng/dl
Total T4	4.87-11.72 µg/dl
TSH	0.4-4.0µIU/ml

The 90 study participants were then divided into 3 groups as follows:

Table 2: Group wise distribution of study participants

Sr. No	Group	Number of study participants	Thyroid profile	Category
1	I	30	Newly diagnosed patients of hypothyroidism having total Serum T4 less than 4.87 µg/dl, total Serum T3 less than 56 ng/dl and Serum TSH more than 4µIU/ml.	Hypothyroid
2	II	30	newly diagnosed patients of hyperthyroidism having total Serum T4 more than 11.72 µg/dL, total Serum T3 more than 188 ng/dL and Serum TSH less than 0.4µIU/ml.	Hyperthyroid
3	III	30	Age and sex matched healthy controls were selected from the relatives of study group subjects. Their total Serum T4 was between 4.87 to 11.72 µg/dl, total Serum T3 between 56 to 188 ng/dl and Serum TSH between 0.4-4.0µIU/ml.	Euthyroid

Resting Diastolic blood pressure of all participants was noted in a supine position after taking their consent. It was ensured that the participants were physically and mentally relaxed and free from any anxiety. Procedure of BP was recording was explained to them beforehand.

Statistical analysis:

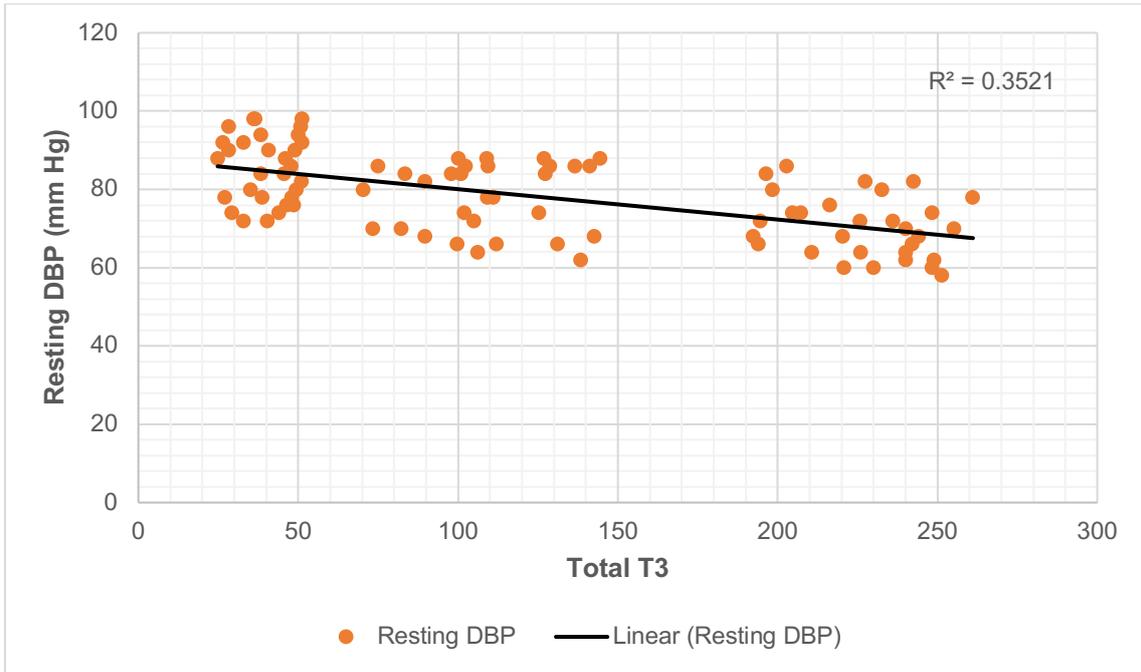
Then Co-efficient of correlation in bivariate relationships was obtained using the Pearson's correlation test.

A "p" value of less than 0.05 was considered as statistically significant (S*) and "P" value of less than 0.001 as statistically highly significant (S***).

Results:

Table 3: Correlation between Total T3 (Tri-iodothyronine) and Diastolic Blood Pressure

Independent variable	Dependent variable	Pearson's Correlation Coefficient "r"	p-value and Statistical Significance
Total T3 (µg/dl)	Resting DBP (mm Hg)	-0.5934	< 0.001 S***

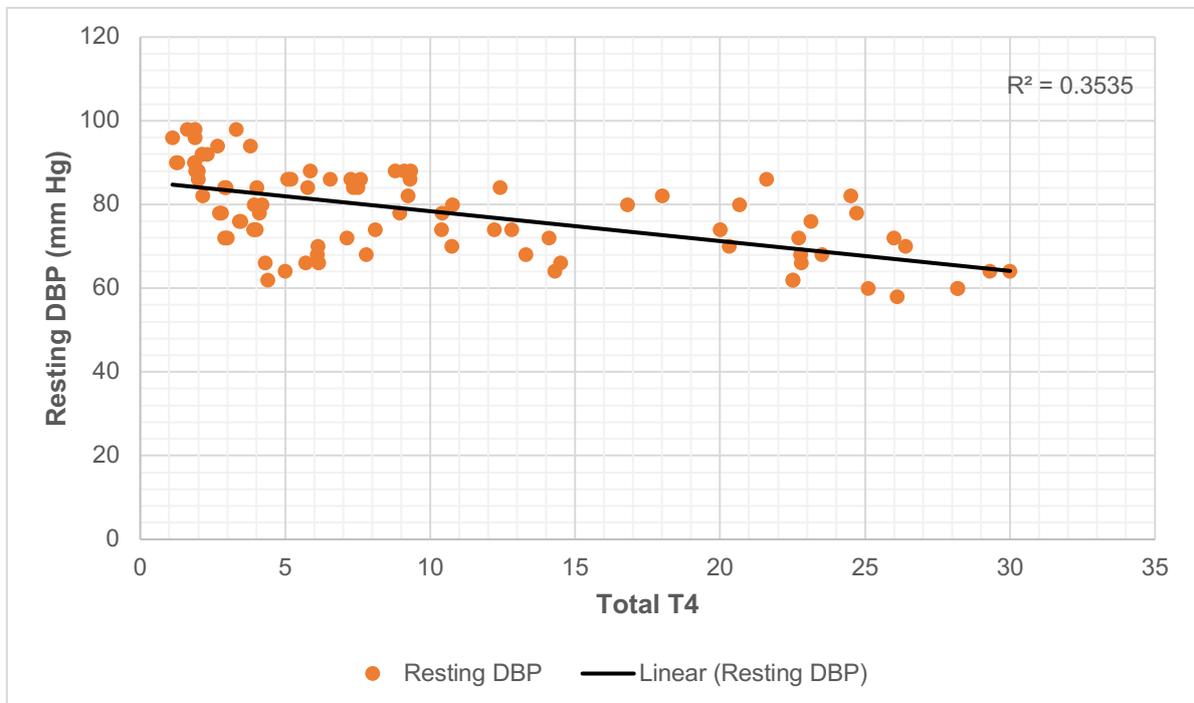


Graph 1: Correlation between Total T3 level and Resting Diastolic Blood Pressure

There is negative linear correlation of total T3 hormone level with resting diastolic blood pressure ($p < 0.001$).

Table 4: Correlation between Total T4 (Thyroxin) level and Diastolic Blood Pressure

Independent variable	Dependent variable	Pearson's Correlation Coefficient "r"	p-value and Statistical Significance
Total T4 ($\mu\text{g/dl}$)	Resting DBP (mm Hg)	-0.5945	< 0.0001 S***

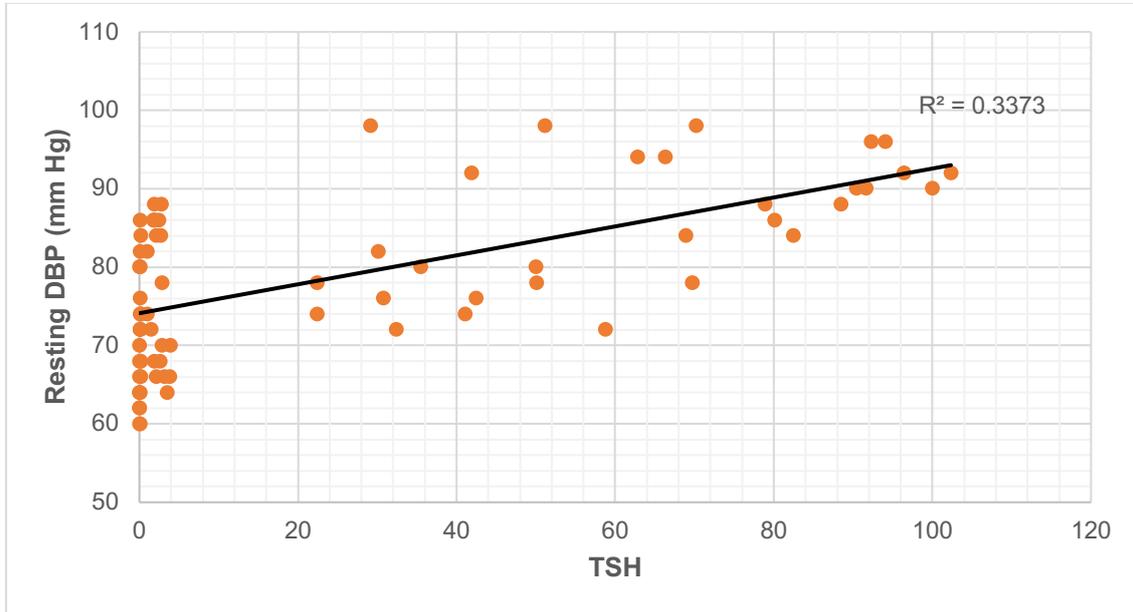


Graph 2: Correlation between Total T4 level and Resting Diastolic Blood Pressure

There is negative linear correlation of total T4 hormone level with resting diastolic blood pressure ($p < 0.001$).

Table 5: Correlation between TSH (Thyroid Stimulating Hormone) level And Resting Diastolic Blood Pressure

Independent variable	Dependent variable	Pearson's Coefficient "r"	Correlation	p-value and Statistical Significance
TSH (μIU/ml)	Resting DBP (mm Hg)	0.5808		< 0.001 S***



Graph 3: Correlation between TSH (Thyroid Stimulating Hormone) level and Resting Diastolic Blood Pressure

There is positive linear correlation of total TSH hormone level with resting diastolic blood pressure ($p < 0.001$).

Discussion

In the present study, an attempt was made to find out correlation of T3, T4 and TSH with diastolic blood pressure in premenopausal women with altered thyroid hormone status.

In the present study, a negative linear correlation of total T3 hormone level with resting diastolic blood pressure ($p < 0.001$) was observed. [Table 3, Graph 1] Table 4 and Graph 2 shows that there was a negative linear correlation of total T4 hormone level with resting diastolic blood pressure ($p < 0.001$). On the other hand, there was positive linear correlation of total TSH hormone level with resting diastolic blood pressure ($p < 0.001$). [Table 5, Graph 3] As T3 and T4 levels increased, resting diastolic blood pressure went on decreasing. Also lesser the TSH level, lesser is the diastolic blood pressure. On the other hand, in hypothyroid subjects with low T3 and T4 levels and high TSH levels, resting diastolic blood pressure value was elevated linearly. Saito I et al studied the association between hypertension and hypothyroidism. They observed higher diastolic blood pressure in hypothyroid patients than in euthyroid patients of corresponding age groups. They also found negative correlation between

diastolic blood pressure and blood level of triiodothyronine (T3) and thyroxin (T4) hormones. [5] Luboshitzky R et al studied female patients of subclinical hypothyroidism and found increased diastolic blood pressure as well as hypertriglyceridemia. [6] Stabouli S et al summarized previous studies on the impact of hypothyroidism on blood pressure and early atherosclerotic process and suggested a possible link between hypothyroidism and diastolic hypertension. They suggested that increased peripheral vascular resistance leads to increased diastolic blood pressure.[7] Mahajan AS et al in his study on twenty two subclinical hypothyroid patients found high diastolic BP in hypothyroid patients.[8] The probable reason for change in diastolic blood pressure is the alteration in peripheral resistance produced due to thyroid hormones. Diastolic blood pressure value reflects degree of peripheral resistance. Peripheral resistance decreases due to peripheral vasodilatation produced by thyroid hormones by following mechanisms.

1. Thyroid hormone causes rapid utilization of oxygen and increased production of heat and carbon-dioxide due to increased metabolic rate. These effects cause vasodilatation. Cutaneous vasodilatation is particularly a prominent feature which helps in dissipation of excess heat produced.[9]

2. Thyroid hormone directly decreases peripheral resistance by dilating arterioles in the peripheral circulation, in addition to endothelial-derived vascular relaxation which involves nitric oxide release and action.[10]

Therefore, in case of hyperthyroidism there is excess thyroid hormone level leading to decreased peripheral resistance and decreased diastolic blood pressure. While in case of hypothyroidism, there is decreased thyroid hormone level leading to increased peripheral resistance and increased diastolic blood pressure.

Conclusion

Thyroid hormone directly or indirectly decreases peripheral resistance by dilating the arterioles. As T3 and T4 levels increase and as TSH levels decrease, resting diastolic blood pressure goes on decreasing linearly. On the other hand, as T3 and T4 levels decrease and as TSH levels increase in a, resting diastolic blood pressure goes on increasing linearly. Hence thyroid hormone concentration should be kept within normal limits by appropriate therapeutic measures so as to prevent ill effects of resultant decreased diastolic blood pressure.

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