# Effect of Hyper- and Hypothyroidism on many physiological parameters and the rate of some diseases

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**Abstract:**

Thyroid diseases are the second most public endocrine system disorder which effect many systems of the body. This work aimed to study the effect of hyper- and hypothyroidism on the blood pressure (systolic and diastolic, hemoglobin level (Hb), fasting blood sugar level (FBS), and decayed, missing, and fulling teeth (dmf-t) and study the frequencies of anemia, hypertension and diabetes in these three groups. This study included forty patients, who were previously diagnosed with hyperthyroidism (20case) and hypothyroidism (20case) as well as 10 healthy as control (male and female) in age group of 30-65 years. There were significant differences in HB levels among the three groups were detected. The lowest was in hypothyroidism and the highest was in control. The frequency of anemia was significantly higher in the hyper- and hypothyroidism compared to control. The systolic blood pressure was significantly higher in the hyperthyroidism group. Conversely, significantly higher diastolic blood pressure in the hypothyroidism group was detected. The frequencies of Hypertension were significantly higher in the hyperthyroidism and hypothyroidism compared to control. There also were significantly differences in the FBS levels among the three groups. The frequency of diabetic was significantly higher in the hyper- and hypothyroidism compared to control. According to obtained data we suggested that all patients with hypothyroidism and hyperthyroidism should be periodically evaluated for probably hematological, cardiovascular, biochemical, and oral changes.

## Introduction:

Thyroid hormones, thyroxine (T4) and tri-iodothyronine (T3), have important roles in cellular and neuronal development, the maturation of bone, growth, metabolism, intracellular protein trafficking modulation, and regulating production of red blood cells by genomic or non-genomic actions [1-4]. Plasma thyroid hormones concentrations are controlled by thyroid hormone axis which included to hypothalamus paraventricular nucleus, anterior pituitary, and thyroid gland. Hypothalamus produces thyrotropin-releasing hormone (TRH) which stimulates anterior pituitary gland to secret thyroid-stimulating hormone (TSH). TSH regulates the plasma thyroid hormones levels [5].

While the main secretary product of the thyroid gland is T4, T3 is the major bio-active form of thyroid hormones [5]. T4 can converse to T3 by Propylthiouracil (6-n-propyl-2-thiouracil; PTU) activity, which is the antithyroid agent inhibits 5-deiodinase hence inactivates thyroid peroxidase (TPO) and blocks intrathyroidal [6, 7]. Thyroid disorders are usually divided into two types, hyperthyroidism and hypothyroidism [8, 9]. While deficiency or absence of thyroid hormones cause hypothyroidism, abundance of it cause hyperthyroidism [10].

Thyroid function test using blood testes including thyroid hormones T3 and T4, as well as TSH measurement have been use to determine the type of thyroid disorder and cause of thyroid dysfunction [10]. They may reveal hyperthyroidism (high T3 and T4), hypothyroidism (low T3, T4), or subclinical hyperthyroidism (normal T3 and T4 with a low TSH) [11].

Thyroid diseases are the second most public endocrine system disorder which effect many systems of the body such as cardiovascular [12], nervous [13], renal [14], digestive [15], reproductive [16], and other systems. It is amongst the most prevalent of medical conditions, especially in women [9].

The aim of this work was to study the effect of hyper- and hypothyroidism on the blood pressure, Hb, FBS, and dmf-t; and study the frequencies of anemia, hypertension and diabetes in these three groups.

## Material and method:

This study included forty patients visited the Baghdad hospital in Iraq, who were previously diagnosed with hyperthyroidism or hypothyroidism (20 volunteers in each group) as well as 10 healthy as control (male and female) in age group of 30-65 years.

***Caries experience:***

It was assessed by calculating the number of decayed, missing, and filled teeth (dmf-t) in all volunteers.

***Blood pressure:***

It was assessed by mercurial pressure measuring device. The individuals were classified to hypertension, hypotension, and normal according the American Heart Association. The normal Blood pressure range: systolic (100-140) mmHg, diastolic (60-90) mmHg.

***Blood Hb:***

5 ml of venous blood was collected from antecubital vein of all individuals by disposable syringe. Blood samples were examined to determine blood Hb by Gemmy hematocrit. The individuals were classified to Polycythemia, Anemia, and normal according the normal rang in adults, in men (13.5-17.5g/dl), and in women (12.0-15.5g/dl.

***Thyroid Function Test (T3, T4, and TSH) and Fasting Blood Sugar tests:***

Blood samples were centrifuged for 5 min at 5000 rpm. The serum samples were examined to determine Hormones (T3, T4, and TSH) using compact desktop Immuno-florescence-analyzer (AFIAS-6/ boditech), and fasting blood sugar by

clinical chemistry analyzer (Mindray Bs-230). The individuals were classified to control, hypothyroidism, and hyperthyroidism depend on thyroid function test results (the normal value of T3 1.17-3.4, T4 4.9-11, and TSH 0.3-3.6 µg/dl). Then, the individuals were classified to diabetic and normal according the FBS test results. The normal level of FBS test is 70-100 mg/dl

***Statistical analysis:***

Results are expressed as mean ± standard division (M±SD) and as frequency of observations percentage (Cases %). Data were analyzed by one-way analysis of variance (ANOVA) followed by Fisher's test for multiple comparisons, using Stat view version 5.0. Differences were considered significant when $p<0.05$.

**Results:**

This study included forty patients, who were previously diagnosed with hyperthyroidism and hypothyroidism (20 volunteers in each group) as well as 10 healthy as control (male and female) in age group of 30-65 years. TSH, T3, and T4 levels in these groups were descript in the table-1.

**Table- 1: descriptive hormones levels in the patients with hyper- and hypothyroidism**

| | Mean TSH (µg/dl)±SD | Mean T3 (µg/dl)±SD | Mean T4 (µg/dl)±SD |
|---|---|---|---|
| **Control (10 Case)** | 1.7±0.4 | 1.9±0.2 | 9.2±0.4 |
| **Hyperthyroidism (20 Case)** | 0.18±0.02 | 17.1±9.9 | 14.7±0.6 |
| **Hypothyroidism (20 Case)** | $10.7\pm3.9^{b}$ | 1.0±0.05 | 3.4±0.1 |

While no polycythemia status was detected, the frequency of anemia was significantly higher in the hyper- and hypothyroidism compared to control (60%, 90%, and 30%, respectively), but the normal was higher in the control compared to hyper- and hypothyroidism (70%, 10%, and 40%, respectively). Significantly differences among HB levels in the three groups were detected. The lowest was in hypothyroidism and the highest was in control (Table-2).

**Table-2: HB level and frequency of Anemia and Normal status in healthy and thyroidism individuals**

| | Mean HB (g/dl) ± SD | Anemia (%) | normal (%) |
|---|---|---|---|
| **Control (10 Case)** | 13.2±1.0 | 30 | $70^{ab}$ |
| **Hyperthyroidism (20 Case)** | $12.0\pm2.1^{ac}$ | $60^{ac}$ | $40^{c}$ |
| **Hypothyroidism (20 Case)** | $10.4\pm1.5^{b}$ | $90^{b}$ | 10 |

a: significantly difference in control vs. hyperthyroidism, b: significantly difference in control vs. hypothyroidism, and c: significantly difference in hypothyroidism vs. hyperthyroidism

While there was no significantly difference between the control and hypothyroidism, the systolic blood pressure was significantly higher in the hyperthyroidism. Conversely, significantly higher diastolic blood pressure in the hypothyroidism group compared to control while no significantly difference between control and hyperthyroidism was detected. The frequencies of Hypertension was significantly higher in the hyperthyroidism and hypothyroidism compared to control (70%, 60%, and 40%, respectively), but the normal was higher in the control compared to hyperthyroidism and hypothyroidism (60%, 30%, and 40%, respectively). No hypotension status was detected in the all volunteers. (Table-3)

**Table-3: Systolic and Diastolic levels and frequency of hypertension and normal status in healthy and thyroidism individuals**

| | Maen Systolic±SD | Maen Diastolic±SD | Hypertension(%) | Normal(%) |
|---|---|---|---|---|
| **Control (10Case)** | 12.5±1.7 | 8.5±0.8 | $40^{ab}$ | $60^{ab}$ |
| **Hyperthyrodisim (20 Case)** | $14.8±1.9^{ac}$ | 8.9±0.9 | 70 | 30 |
| **Hypothyrodisim (20 Case)** | 13.0±2.3 | $9.6±1.0^{bc}$ | 60 | 40 |

a: significantly difference in control vs. hyperthyroidism, b: significantly difference in control vs. hypothyroidism, and c: significantly difference in hypothyroidism vs. hyperthyroidism

While no significantly differences in the frequencies of diabetic and normal status between hyper- and hypothyroidism were detected, the frequency of diabetic was significantly higher in the hyper- and hypothyroidism compared to control (80%, 70%, and 50%, respectively) but the frequency of normal status was significantly higher in the control compared to hyper- and hypothyroidism (50%, 20%, and 30%, respectively). There also were significantly differences among the FBS levels in the three groups. The highest was in the hypothyroidism and the lowest was in the control group (table-4).

**Table-4: FBS level and frequency of diabetic and normal status in healthy and thyroidism individuals**

| | Mean FBS±SD | Diabetic (%) | Normal (%) |
|---|---|---|---|
| **Control (10 case)** | 141±70.9 | 50 | $50^{ab}$ |
| **Hyperthyrodisim (20 case)** | $169.6±78.6^{a}$ | $80^{a}$ | 20 |
| **Hypothyrodisim (20 case)** | $172,8±94.9^{bc}$ | $70^{b}$ | 30 |

a: significantly difference in control vs. hyperthyroidism, b: significantly difference in control vs. hypothyroidism, and c: significantly difference in hypothyroidism vs. hyperthyroidism

The Dmf-t number was significantly higher in the hyperthyroidism compared to control and hypothyroidism. While the mean±SD of dmf-t number was (6±1.8) in the

hyperthyroidism, it was (4,8±1.1) in control and (4,4±0.9) in the hypothyroidism figure-1

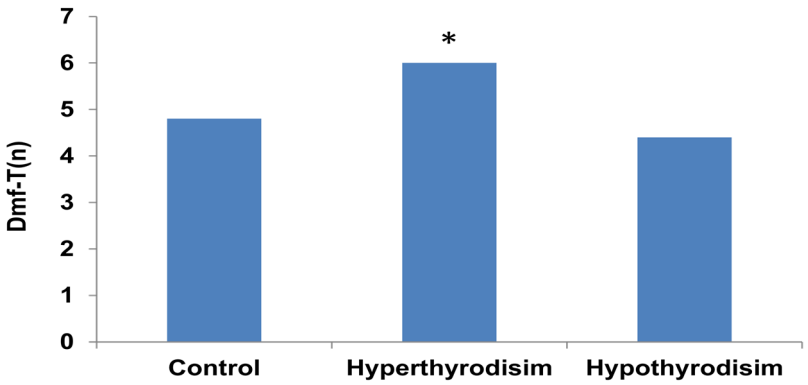


**Figure-1: the dmf-t value in the healthy and thyroidism in individuals**

**Discussion:**

It is well established that thyroid hormones have important effect on erythropoiesis by hyper proliferation of immature erythroid progenitors and increasing secretion of erythropoietin through the expression of erythropoietin's gene. Generally it seems that hypothyroidism causes hypoplasia in all myeloid cell lineages; stem cells lead to the production of specific types of blood cells including erythrocytes, granulocytes, and platelets; and hyperthyroidism result in hyperplasia [17, 18]. Hypothyroidism can cause various forms of anemia (normochromic-normocytic, hypochromic-microcytic or macrocytic) by decrease the oxygen metabolism. Microcytic anemia is generally due to poor Iron absorption or loss it by bleeding, while macrocytic anemia causes poor absorption of vitamin B12, folic acid, malignant anemia and inadequate nutrition [18]. On the other hand, anemia is often not seen in hyperthyroidism patients, while there were red blood cells in this situation, but when present anemia, may be morphologically similar to those observed in hypothyroidism [19, 20]. The results of this study shows anemia frequencies 90% in hypothyroidism and 60% in hyperthyroidism compared to 30% in the control group while the mean of HB was in normal rang in control and hyperthyroidism compared it in hypothyroidism which was significantly low. Dorgalaleh *et al* (2013) which reported HB and HCT were statistically different between patients with hypothyroidism and hyperthyroidism and control [21]. Geetha J and Srikrishna R in 2012 reported that there were not any significant difference in RBC parameters like HB and HCT between patients with hypothyroidism and hyperthyroidism and control group [22], but Kawa MP and et al in 2010 showed significantly higher RBC, HB and HCT in patients with hyperthyroidism than control groups while RBC and HB were decreased in hypothyroidism [18].

Increase or decrease the action of thyroid hormones on some molecular pathways in the heart and blood vessels cause related cardiac arrhythmias. It is established that hyperthyroidism leads to cardiovascular condition hyperdynamic (increase the output of the heart and decrease the resistance of systemic vascular), whereas hypothyroidism cause adverse changes. The hyperdynamic of cardiovascular is

associated with faster heart rate, enhanced the function of left ventricular systolic and diastolic [23]. Hypertension caused by hyper- and hypothyroidism. To compensate for the decrease of thyroid hormones, noradrenaline is secreted in hypothyroidism which causes diastolic blood pressure [24]. Any increasing in the T3 level cause reduce systemic vascular resistance, resistance to blood flow, which increase systolic blood pressure [25]. These evidences can explain our results, higher systolic blood pressure in the patients with hyperthyroidism and diastolic blood pressure in the patient with hypothyroidism compared to control, and the frequency of the hypertension was 70% in the patient with hyperthyroidism and 60% in the patient with hypothyroidism compared to 40% in the control.

There is a deep relationship between diabetes mellitus and thyroid disorder [26]. A wide range of studies have demonstrated a complex combination of biochemical, genetic, and hormonal correlations that reflect this physiological pathological association [26, 27]. The major cause of thyroid-dysfunction associated diabetes mellitus is Autoimmunity [28, 29]. It have been investigated that Hashimoto's thyroiditis, hypothyroidism type, or Graves' disease, hyperthyroidism type, associated with diabetes mellitus [30]. The results of this study shows significantly higher FBS in the hyper- and hypothyroidism compared to control and the frequencies of diabetes were 80% in the hyperthyroidism and 70% in the hypothyroidism compared to 50% in the control.

As there are systemic manifestations of thyroid disease, there are oral manifestations. Cretimisim, childhood hypothyroidism, is characterized by thick lips, large protruding tongue (macroglossia), malocclusion and delayed eruption of teeth [31]. Increased susceptibility to caries, periodontal disease, enlargement of extraglandular thyroid tissue (mainly in the lateral posterior tongue), maxillary or mandibular osteoporosis, accelerated dental eruption are the oral manifestations of thyrotoxicosis [32]. as conclusion, while the characteristic macroglossia, dysgeusia, delayed eruption, poor periodontal health, altered tooth morphology and delayed wound healing are The common oral findings in hypothyroidism [33]; increased susceptibility to caries, periodontal disease and others are The oral manifestations of thyrotoxicosis [32]. These evidences can explain our results, increase number of dmf-t in the hyperthyroidism compared to hypothyroidism and control groups.

According to obtained data we suggested that all patients with hypothyroidism and hyperthyroidism should be periodically evaluated for probably hematological, cardiovascular, biochemical, and oral changes.

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