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Relationship between Age and Thyroid-Stimulating Hormone, Thyroxine, and Triiodothyronine Levels and Incidence of Anti-Thyroid Peroxidase Antibodies in Iraqi Adult Women with Thyroid Diseases

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Abstract: Aims: *Study investigated relationship between age and hyperthyroidism. It investigated relationship between thyroid-stimulating hormone (TSH), thyroxine (T4), and triiodothyronine (T3) levels and young and middle-aged women. It studied relationship between thyroid peroxidase antibodies (TPO-Ab) and polycystic ovary syndrome (PCOS), anemia and short stature.*

Methods: *Twenty women with thyroid disorders were enrolled. Serum TSH, T4, T3, and TPO-Ab levels were measured using mini-VIDAS kits.*

Results: *Significant incidence of hyperthyroidism among ages less than fifty years (P=0.03). Comparable mean levels of TSH, T4, and T3 among age groups (<50 years) and (50≤age≤55years), (P=0.22, P=0.11, P=0.34, respectively). Strong correlation was between Graves' disease (GD) and (PCOS) and anemia. Hashimoto's thyroiditis (HT) associated with short stature.*

Conclusions: *Hyperthyroidism incidence is more among young and middle-aged women. Impact of young and middle ages were insignificant on TSH, T4, and T3 levels. GD strongly correlated with (PCOS) and anemia. HT strongly associated with short stature.*

I. Introduction

Thyroid gland is located in the anterior portion of the neck below and bilateral to the thyroid cartilage (1). Thyroid gland is composed of two lateral lobes connected by isthmus. Normally, the right lobe is larger than the left one and in some persons a superior portion of glandular tissue, or pyramidal lobe is found. The parathyroid glands are embedded in the thyroid gland. Thyroid gland secretes three hormones: thyroxine (T4), triiodothyronine (T3), and calcitonin. Thyroxine (T4) and triiodothyronine (T3) hormones impact metabolism in the whole body and are included with the use of oxygen. Calcitonin regulates serum calcium and phosphorous concentrations. (1).

Thyroid hormones are included in many physiological processes organizing basal metabolic rate, induce metabolic pathways as gluconeogenesis, lipolysis, and lipogenesis (2). Thyroid hormones stimulate adrenergic nervous system to generate heat as a consequence of cold exposure (2).

It is revealed that thyroid-stimulating hormone (TSH) levels are influenced by age (3). It is found that thyroid hormones secretion, metabolism, and activity are affected and change with age (4).

Hyperthyroidism is a syndrome with hypermetabolic state attributed to elevated free serum thyroxine (T4) and/or triiodothronine (T3) (5). Hypothyroidism is the failure of the thyroid gland to synthesize and release sufficient thyroid hormones to meet the metabolic needs (6). Hypothyroidism and hyperthyroidism are grouped into subclinical [changes in only thyroid-stimulating hormone (TSH) concentration] and overt stages [alterations in thyroid-stimulating hormone (TSH) and thyroid hormones concentrations] (7).

Anemia refers to a condition where hemoglobin (Hgb) level is of 110gm/L or less in women and 130gm/L or less in men (8).

Autoimmune diseases show a range of disorders caused by inflammation of body organs as a result of antibodies produced against self-structures and because of cytotoxicity of immune T cells (9). Autoimmune thyroid

diseases occur by the presence of anti-thyroid peroxidase (TPOAb), anti-thyroglobulin (TgAb), and anti-thyroid-stimulating hormone receptor (TRAb) antibodies (9). Most common autoimmune thyroid diseases involve Hashimoto's thyroiditis (HT) and Graves' disease (GD)(10).

Polycystic ovary syndrome (PCOS) is a condition associated with high androgen levels, i.e. hyperandrogenism, irregular menstrual cycle, chronic insulin resistance, and anovulation, situations accompanied by obesity in most of them (11). In females, hirsutism, a clinical symptom of hyperandrogenism, is an excessive terminal hair growth that takes on a male pattern distribution (12).

Normal thyroid function is dependent on the presence of a lot of trace elements such as iron, iodine, zinc, and selenium for both thyroid hormones synthesis and metabolism (8). These elements deficiency can lead to thyroid functions impairment (8).

Hypothyroidism is defined as failure of the thyroid gland to produce enough thyroid hormone to affect the needs of metabolism of the human body (6). The diagnosis of overt hypothyroidism is shown with elevated serum thyroid-stimulating hormone (TSH) concentration in excess of 10 µIU/ml and low free thyroxine (T4) concentration or low total thyroxine (TT4) levels, i.e. levels under the reference range (6, 13). Subclinical hypothyroidism (SH), also known as mild hypothyroidism is when serum thyroid-stimulating hormone (TSH) concentration is increased but remains typically between 5 µIU/ml and 10µIU/ml and serum thyroxine (T4) concentration is within the reference range (13). Subclinical thyroid disease patients suffer from few or no symptoms of thyroid dysfunction and thus subclinical hypothyroidism (SH) is diagnosed in the laboratory (14). Subclinical hypothyroidism (SH) can resolve or stay unchanged, but within years this condition can progress to overt hypothyroidism (15).Primary thyroid gland failure/ or insufficient thyroid gland induction by the hypothalamus or by the pituitary gland can lead to hypothyroidism (6)Untreated hypothyroidism may result in complications such as dyslipidemia, hypertension, cognitive impairment, neuromuscular dysfunction, and infertility (6). Hypothyroidism is linked with decreased thermogenesis, decreased metabolic rate, and with elevated body mass index (BMI) and consequent obesity prevalence (16).

Dwarfism, also called short stature, is sometimes defined when an adult height is of less than one hundred and forty-seven centimeters, regardless of sex (17). The complicated process of growth is impacted by plenty of genetic factors during prenatal and postnatal periods (18).Idiopathic short stature (ISS) or dwarfism is correlated with hypothyroidism (18).

This study aimed to investigate:

1-The relationship between short stature and hypothyroidism.

2-The relationship between age and incidence of hyperthyroidism.

3-The relationship between age and thyroid-stimulating hormone (TSH), thyroxine (T4), and triiodothyronine (T3) levels for Iraqi adult women with hyperthyroidism.

4-The relationship between thyroid peroxidase-antibodies (TPO Ab) and the contributing factors for Iraqi adult women with Graves' and Hashimoto's thyroiditis diseases.

II. Materials and Methods

Twenty adult women with thyroid diseases attending private labs in Baghdad, Iraq during the period from July 2019 to December 2019 were included in this study. Information concerning age and suffering from diseases other than thyroid diseases were obtained from all patients. Diagnosis of thyroid diseases were by specialist physicians the patients were attending. Four patients (20%) with Graves' disease (GD) were suffering from polycystic ovary syndrome (PCOS) and that their diagnosis was by specialist physician. Ages of included patients ranged from twenty-two to fifty-five years old. Of these twenty cases, two (10%) were subclinical hypothyroidism, two (10%) were severe hypothyroidism, and sixteen (80%) were hyperthyroidism.

2.1 Measurement of Height

The height of all women was measured by keeping their head in Frankfurt plane while occiput, shoulder, buttocks and heel touching vertical board (19). Dwarfism or short stature is considered when adult height is less than one-hundred and forty-seven centimetres (17).

2.2 Blood Sampling

Informed and signed consent was obtained from all patients enrolled in this study. Intravenous blood samples were obtained and centrifuged at 2500rpm for 15 minutes. Serum thyroid-stimulating hormone (TSH), serum thyroxine (T4), and serum triiodothyronine (T3) concentrations were measured using available mini-VIDAS kits (BIOMERIEUX/France). Serum thyroid peroxidase-antibodies (TPO Ab) were measured using available mini-VIDAS kits (BIOMERIEUX/France).

Table(1): Normal ranges for thyroid-stimulating hormone, thyroxine, triiodothyronine hormones and thyroid peroxidase-antibodies levels in sera

Thyroid Hormones	**Normal Ranges**
Thyroid-stimulating hormone (TSH)	(0.27-4.20) µIU/ml
Thyroxine (T4)	(5.13-14.06)Ug/dL
Triiodothyronine (T3)	(0.79-1.58)ng/ml
Antibodies	**Normal Ranges**
Thyroid peroxidase-antibodies (TPO Ab)	(10-50)IU/ml

µIU/ml: microinternational unit per milliliter, Ug/dL: microgram per deciliter, ng/ml: nanogram per milliliter, IU/ml: international unit per milliliter

Table(1) shows the normal levels for thyroid-stimulating hormone, thyroxine, triiodothyronine hormones and thyroid peroxidase-antibodies as obtained from the leaflets in the kits.

2.3 Statistical Analysis

Statistical analysis was performed according to SAS. 2012. Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.

III. Results

This study included twenty Iraqi adult women suffering from thyroid diseases. Ages of hyperthyroidism women were from twenty-three to fifty-five years (41.37±2.59years). Of these hyperthyroidism women, mean ages (<50) years age group was (33.00±1.36)years, and mean ages (50≤age≤55) years age group was (52.14±1.01)years. Ages of women with Graves' disease (GD) ranged from thirty to thirty five years (34.16±0.56years). Ages of subclinical hypothyroidism (SH) women were from forty to forty-three years (41.50±1.50years), and ages of severe hypothyroidism women, who were Hashimoto's thyroiditis (HT), were from twenty-two to twenty-four years (23.00±1.00years).

Height of women with hyperthyroidism ranged from 1.63meters to 1.66meters (1.65.18±0.21meters). Height of women with subclinical hypothyroidism (SH) ranged from 1.60meters to 1.62meters (1.61±1.00meters). Height of women with severe hypothyroidism ranged from 1.45meters to 1.52meters (1.48.50±3.50 meters), and this indicated that one woman was with dwarfism or short stature.

Mean levels of thyroid-stimulating hormone (TSH) for women with hyperthyroidism was 5.23±0.53µIU/ml. Mean levels of thyroxine (T4) for women with hyperthyroidism was 94.18±4.08µg/dL. Mean levels of triiodothyroinine (T3) for women with hyperthyroidism was 1.45±0.06ng/ml. Mean levels of thyroid-stimulating hormone (TSH) for women with subclinical hypothyroidism was 7.90±0.10µIU/ml. Mean levels of thyroxine (T4) for women with subclinical hypothyroidism was 8.31±0.30µg/dL. Mean levels of triiodothyronine (T3) for women with subclinical hypothyroidism was 1.13±0.15ng/ml. Mean levels of thyroid-stimulating hormone (TSH) for women with severe hypothyroidism was 41.96±0.14µIU/ml. Mean levels of thyroxine (T4) for women with severe hypothyroidism was 5.17±0.03µg/dL. Mean levels of triiodothyronine (T3) for women with severe hypothyroidism was 1.10±0.01ng/ml.

Table (2) showed significant relationship between age and incidence of hyperthyroidism. Six out of nine women (66.66%) with hyperthyroidism within age group (<50years) were with Graves' disease (GD) as they were complaining from significant increase in thyroid peroxidase antibodies (TPO Ab).

Table (2): Distribution of women with hyperthyroidism according to age groups

Age Groups (Years)	Number of Women and (%)
<50	9 (56.25%)
50≤Age≤55	7 (43.75%)
Total number of women	16 (100%)
Chi-square	5.02*
P-value	0.03

(%): percentage, P: probability,(P <0.05) was considered significant.

Table (3) revealed comparable mean levels of thyroid-stimulating hormone (TSH) according to age groups for women with hyperthyroidism.

Table (3): Distribution of women with hyperthyroidism according to age groups and thyroid-stimulating hormone concentrations

TSH Levels / Age Groups (Years)	TSH Levels (Mean±SE) (µIU/ml)	Number of Women and (%)
<50	5.03±0.75	9 (56.25%)
50≤Age≤55	5.49±0.81	7 (43.75%)
Total Number	-	16 (100%)
t-test	0.88 NS	-
P-value	0.22	-

TSH: thyroid-stimulating hormone, Mean± SE: Mean± Standard Error, µIU/ml: micro-international unit per milliliter, (%):percentage, P: probability, NS: none-significant; (p <0.05) was considered significant.

Table (4) exhibited non-significant changes in mean levels of thyroxine (T4) hormone in age group (<50)years compared to the other age group (50≤age≤55)years for women with hyperthyroidism.

Table (4): Distribution of women with hyperthyroidism according to age groups and thyroxine hormone levels

T4 Levels / Age Groups (Years)	T4 Levels (Mean±SE) (µg/dL)	Number of Women and (%)
<50	97.83±3.80	9 (56.25%)
50≤Age≤55	89.47±8.01	7 (43.75%)
Total Number of Women	-	16 (100%)
t-test	13.48 NS	-
P-value	0.11	-

T4: thyroxine, Mean± SE: Mean± Standard Error, µg/dL: microgram per deciliter, (%): percentage, NS: non-significant, P: probability, (P<0.05) was considered significant.

Table (5) presented comparable mean levels for triiodothyronine (T3) hormone according to age groups for women with hyperthyroidism.

Table (5): Distribution of women with hyperthyroidism according to age groups and triiodothyronine hormone levels

T3 Levels / Age Groups (Year)	T3 Levels (Mean±SE) (ng/ml)	Number of Women and (%)
<50	1.47±0.06	9 (56.25%)
50≤Age≤55	1.41±0.11	7 (43.75%)
Total Number of Women	-	16 (100%)
t-test	0.29 NS	-
P-value	0.34	-

T3: triiodothyronine, Mean±SE: Mean ± Standard Error, ng/ml : nanogram per milliliter, (%): percentage, P: probability, (P<0.05) was considered significant.

Table (6): Distribution of women with thyroid peroxidase-antibodies according to thyroid diseases

TPO-Ab Levels / Thyroid Diseases	TPO-Ab Levels (Mean±SE) (IU/ml)	Number of Women And (%)
Hyperthyroidism	263.36±8.14	6 (30%)
Hypothyroidism	277.50±7.50	2 (10%)
Total Number of Women	-	20 (100%)

TPO-Ab: thyroid peroxidase antibodies, (Mean±SE): Mean±Standard Error, IU/ml: international unit per milliliter, (%): percentage.

Six women(30%) with hyperthyroidism were with high levels of thyroid peroxidase antibodies, i.e. they were with Graves' disease (GD). Of them four cases (20%) were with polycystic ovary syndrome (PCOS) and showed notable clinical symptoms of hirsutism, and two cases (10%) suffered from severe anemia. The two cases (10%) with severe hypothyroidism were with high levels of thyroid-peroxidase antibodies (TPO-Ab), i.e. they were with Hashimoto's thyroiditis (HT).

IV. Discussion

Studies revealed that thyroid disorders were ten times more common in females than in males (20). Preponderance of females with autoimmune thyroid diseases (AITDs) can be illustrated that women are with higher estrogen levels than men and that estrogen decreases $CD4^+/CD8^+$ cell ratio and tumor necrosis factor-alpha (TNF-α) cytotoxicity in T cells and elevates immunoglobulin (Ig) secretion, B cell survival, polyclonal activation as well as immunoglobulin-G (IgG) and immunoglobulin-M (IgM) synthesis in peripheral blood mononuclear cells (PBMCs) (9).

Thyroxine (T4) and triiodothyronine (T3) concentrations in blood are regulated by the hypothalamic-pituitary-thyroid axis. Under the effects of external stimuli such as metabolic demand, stress, diseases, low concentrations of thyroxine (T4) and triiodothyronine (T3), thyrotropin-releasing hormone (TRH) is secreted by the hypothalamus(21).

Thyrotropin-releasing hormone (TRH) is released from the hypothalamus and via the hypophyseal portal circulation it reaches the anterior pituitary gland, activates the thyrotropin-releasing hormone (TRH) receptors and thereby stimulates the secretion of thyroid-stimulating hormone (TSH) which stimulates its own receptors on the follicular cells of the thyroid gland (3). This leads to increased cellular uptake of iodine from the blood, increased synthesis of thyroglobulin and release into the blood triiodothyronine (T3) and thyroxine (T4) hormones through the induction of thyroid peroxidase (TPO) enzyme. There is an inverse relationship between serum thyroxine (T4), serum triiodothyronine (T3) levels and serum thyroid-stimulating hormone (TSH) levels which is attributed to hormonal feedback circuits, and thus low thyroxine (T4) hormone levels (as seen in hypothyroidism) and high thyroxine (T4) hormone levels (as seen in hyperthyroidism) are bound tightly with high and low thyroid-stimulating hormone (TSH) levels, respectively (3).

Enlargement of the thyroid gland is called goiter (1). Simple goiter is incident for about 75% of all thyroid gland swellings (21). Among cases with hyperthyroidism, Graves' disease (GD) cases account for about 60% to 80% . Thyrotoxicosis indicates an excess of thyroxine (T4) and triiodothyronine (T3) hormones in the blood (22). The main risk factor for Graves' disease (GD) is female gender and this is explained in part due to the modulation of the autoimmune response by the hormone estrogen (23).

Subclinical hypothyroidism (SH) refers to the condition where thyroid-stimulating hormone (TSH) levels are above the reference and both thyroxine (T4) and triiodothyronine (T3) hormones levels are within normal ranges (3). Subclinical hypothyroidism (SH) is a common disease in the population, especially among middle-aged and elderly individuals (24). This disorder increases with age and is more frequent among women than men (24).

A study conducted in Korea revealed that lowest thyroid-stimulating hormone (TSH) concentrations were in middle aged persons and the higher concentrations were in younger and elderly age groups (3).

Peeters (2008) showed that serum thyroxine (T4) levels remain unchanged with aging beyond sixty years of age (25). Our study included young and middle aged women with hyperthyroidism but showed acceptance with the Peeters (2008) findings. He also referred to that in elderly individuals beyond sixty years of age serum thyroid-stimulating hormone (TSH) and triiodothyronine (T3) hormone levels were decreased(25). This did not agree with our findings as our groups were young and middle-aged women with hyperthyroidism.

Although decreased thyroid-stimulating hormone (TSH) concentrations results in a decreased thyroxine (T4) hormone secretion in the elderly patients, but what is found is that serum thyroxine (T4) hormone concentrations remain unchanged and this is explained by the fact that thyroxine degradation by outer ring de-iodination decreases with age (26). Impact of age on thyroid-stimulating hormone (TSH), thyroxne (T4), and triiodothyronine (T3) becomes clear after age of sixty years (26).

Hypothyroidism is more in females than in males and its predominance increases with age (6). The commonest etiology of hypothyroidism is autoimmune thyroid disorders (AITDs) (6).

Inherited genetic factors contribute to normal variation in adult height (18). In addition, there is a significant role of environmental factors affecting individual height (18). Short stature can occur as a result of many causes such as endocrine disorders (27). Pediatric endocrine disorders have disastrous effects on weight and height growth and hence, adversely impact child development (27). Extreme shortness can be seen clearly in children with endocrine disorders. Among endocrine disorders is hypothyroidism. Thyroxine (T_4) deficiency as seen in hypothyroidism, has a devastating effect on child growth especially height (27). Hashimoto's thyroiditis (HT) is an autoimmune thyroiditis and it is documented it causes delay in skeletal maturation. It was found that patients with severe hypothyroidism suffered from growth failure and delayed puberty (27). High concentrations of thyroid-stimulating hormone (TSH) in hypothyroidism directly and strictly affect bone metabolism through obstruction of osteoclast formation and survival, osteoblast differentiation and expression of collagen 1 (28).

A study included children with congenital hypothyroidism with ages ranged from two to twelve years and were suffering from pathological short stature. These children showed considerable low levels of both hormones thyroxine (T4) and triiodothyronine (T3) (29). These findings agreed with our results as in the two cases with severe hypothyroidism, one was dwarfism and the other was very short, and that the two cases were complaining from Hashimoto's thyroiditis (HT).

A study showed that the occurrence of hyperthyroidism, in particular Graves' disease (GD), was mostly between thirty and fifty years of age, but could also affect at any age (30). Grave's disease (GD) is the commonest cause of hyperthyroidism and it is realized that it happens in women with ages range from twenty to forty years but can incident at any age (31).

It was documented that serum thyroid-stimulating hormone (TSH), free thyroxine (T4), and free triiodothyronine (T3) levels change with aging (4).

Thyroid peroxidase (TPO) is a poorly glycosylated membrane-bound enzyme, capable of iodine (I_2) oxidation and iodination of tyrosyl residues of thyroglobulin (Tg) compound (9). Thyroid peroxidase (TPO) enzyme is known as a microsomal antigen due to its intracellular localization. Anti-thyroid peroxidase (anti-TPO) antibodies in conditions of autoimmune thyroid diseases (AITD) are able to fix complement, devastate thyrocytes, and function as competitive inhibitors of the activity of the enzyme thyroid peroxidase. Anti-thyroid peroxidase (anti-TPO) antibodies induce oxidative stress (OS) via lessening antioxidant potential, progressed

glycosylation products, and oxygen metabolic compounds in the blood. However, their role in thyroid damage in comparison with T cell and cytokine-mediated apoptosis is little (9).

Anti-thyroid peroxidase (Anti-TPO) autoantibodies are linked to the concentrations of thyroid-stimulating hormone (TSH) and these autoantibodies were considered to predict hyperthyroidism and hypothyroidism development (10).

Hirsutism refers the development of excessive male-pattern hair in females after puberty (32). Non-hyperandrogenic hirsutism as hyperthyroidism or hypothyroidism can be considered a cause of hirsutism. Hirsutism is most often due to hyperproduction of androgens, especially testosterone, of ovarian or adrenal origin (32). Hirsutism is a clinical symptom of polycystic ovary syndrome (PCOS) (12).

Thyrotoxicosis stimulated by Graves' disease (GD) is shown to be combined with menstrual anomalies though, ovulation normally happens in most cases (33). The high levels of sex-hormone-binding-globulin (SHBG), elevated estradiol (E2), testosterone and androstenedione are present in these abnormalities, i.e., polycystic ovary syndrome (PCOS) and Graves' disease (GD) (33). Women with Graves' disease (GD) were found with significant alterations in steroid hormones (34). Janssen *et al*. (2004) recorded that the occurrence of chronic autoimmune thyroiditis was 23.9% (47/175) in women complaining from polycystic ovary syndrome (PCOS), and they also recorded two patients with Graves' disease (GD) in their polycystic ovarian syndrome (PCOS) group (33). The coincidence of polycystic ovary syndrome (PCOS) and Graves' disease (GD) in women can assure the role of autoimmunity in the creation of polycystic ovary syndrome (PCOS) (34).

Women with polycystic ovary syndrome (PCOS) typically have higher estrogen levels than healthy women (12). High levels of estrogen can be attributed to increased levels of sex hormone binding globulin (SHBG), elevated levels of testosterone and androstenedione and their elevated conversion to estrogen (12). Elevated estrogen concentrations decrease T helper1 (Th1) pro-inflammatory pathways and elevate T helper2 (Th2) anti-inflammatory pathways (9). This result in higher production of antibodies by B lymphocytes (9).

Graves' disease (GD) is an autoimmune disorder related to hyperthyroidism (35). Both thyrotoxicosis and Graves' disease (GD) autoimmune response impact many tissues and their functions negatively, involving hematopoiesis (35).

Das *et al*. (1975) studied twenty-one cases with hyperthyroidism of which five were suffering from anemia (36). The researchers revealed increased erythropoesis with erythrocytosis and increased serum erythropoietin (Epo) concentrations in these cases. They reached to evidence that erythropoietin (Epo) provoked these effects (36). Besides the erythropoetic influences of thyroid hormone, most patients complaining from thyrotoxicosis present with normal hemoglobin (Hgb) concentrations (35). Volume of blood is elevated in hyperthyroidism by about 6% 21 and this can function to partially counterbalance the erythropoesis stimulated by thyrotoxicosis. Moreover, red blood cell (RBC) life span may be shortened and some thyrotoxic patients may exhibit ineffective erythropoesis. Thyroxine (T4) may affect iron incorporation into red blood cells (RBCs) (35). Researchers have assumed a "suppressive effect" of supra-physiologic doses of thyroid hormone on erythropoiesis (37). Other researchers have presumed a contribution of secondary causes including autoimmune correlated with vitamin B12 and iron deficiency (38). It was proposed that anemia incident more frequently in severe or protracted hyperthyroidism patients, while other literature did not find such match (39-40). A study did not observe a correlation between degree of hyperthyroidism and hemoglobin (Hgb) that ranged over normal and anemic levels, but newly diagnosed Graves' disease (GD) anemic patients did exhibit higher mean total thyroxine (TT4) than non-anemic patients (35). It was concluded that it was possible that thyrotoxicosis uniformly could decrease hemoglobin (Hgb) in Graves' disease (GD) patients but somehow less become struggling with anemia (35).

V. Conclusions

This study found significant relationship between ages less than fifty years and incidence of hyperthyroidism, especially in cases suffering from Graves' disease (GD). Non-significant impact of young and middle ages on thyroid-stimulating hormone (TSH), thyroxine (T4), and triiodithyronine (T3) levels for hyperthyroidism women. It was found significant relation between Graves' disease (GD) and polycystic ovary syndrome (PCOS), and anemia . Congenital Hashimoto's thyroiditis strongly associated with short statured women.

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