Effect of Thyroid Disorders on Some Biochemical Parameters in Women

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ABSTRACT
The current study aimed to determine the effect of thyroid disorder on kidney function, some hormones, total protein, and glucose in women. The study sample was divided into two groups, the first a (control group) healthy women and the second a group of patients with thyroid disorders (hypothyroidism, hyperthyroidism) in both pregnant and non-pregnant women. The results of the current study showed a significant decrease in the concentration of (T3, T4) and a significant increase in the concentration of TSH in the second group when compared with the control group and the third group, while the third group recorded a significant increase in the concentration of (T3, T4). The results of the current study also showed a significant decrease in the concentration of (estrogen) in the second group when compared with the control group and the third group, and a significant increase in the concentration of (progesterone) in the group. The third group was compared with the healthy group and the second group among non-pregnant women. The results also recorded a significant increase in the concentration of(estrogen). In the second and third groups, when compared with the control group in pregnant women, on the other hand, the results indicated a significant increase in FSH concentration and prolactin in the second group when compared with the healthy group, and a significant increase in the concentration of prolactin and LH in the third group when compared with the control group in non-pregnant women. As for pregnant women, the results showed a significant decrease in the concentration of (LH). And a significant increase in the concentration of (prolactin) in the second and third groups when compared with the control group.

1. Introduction

The thyroid gland and its hormones have multifaceted functions. In the development of organs and in the balanced control of basic functions. Physiological mechanisms such as body growth and energy. Spending on all vertebrates. Thyroid hormones are subject to the control of TSH, which is produced by the pituitary gland and is the main regulator of the process. Thyroid gland growth and function from late fetus to adulthood [1] The pituitary gland controls the function of most other endocrine glands, so it is sometimes called the master gland In contrast, the pituitary gland is largely controlled by the hypothalamus region by detecting the levels of hormones produced by the glands that are under the control of the pituitary gland (target glands) where there is a close relationship between the pituitary gland - the hypothalamus and the ovary due to the pituitary and thyroid systems, as central regulatory mechanisms are used common between the function of the reproductive system and the thyroid gland. The pituitary gland is through which the hormones under its control are regulated (luteinizing hormone - LH follicle-stimulating hormone - FSH, prolactin - PRL, thyroid-stimulating hormone TSH, and these hormones are controlled by the hypothalamus through the release of thyrotropin hormone TRH

which is not only a stimulant of TSH, but also of PRL and therefore any defect in the pituitary and thyroid system will lead to disorders not only in the gonads, but also in the PRL. In many ways, represented by the organization, synthesis and secretion of hormones. Changes in the structure of the pituitary gland and enlargement of its cells have been observed as a result of primary hypothyroidism. Low levels of thyroid hormones lead to overproduction of TRH, followed by enlargement of the thyroid and pituitary cells [2]. The thyroid gland maintains the balance of the body's metabolism and that thyroid hormones and TSH are necessary for normal growth within the body, and the most important effect in terms of its work is to maintain its hormones on the metabolic rate and oxygen consumption in the body's tissues**,** such as regulating carbohydrates and metabolizing fats and protein [3] [4].

2. Methods

Collecting blood samples and working

The study sample included 200 medical cases from women attending Al-Rifai Teaching Hospital. Blood samples were collected periodically by direct withdrawal from the patient and then left to clot at room temperature. The blood samples were centrifuged for 10 minutes in a centrifuge at 3500 rpm to separate the serum. Serum samples were stored in the freezer at a temperature of (-20°C) for later chemical testing.

Measuring the level of TSH, T4, and T3

The concentration of TSH, T4, and T3 in the women's serum was measured using the Maglumi800 device. From Snaibe company through ready-made kits of German origin.

Measuring the level of sex hormones

The concentration of progesterone, testosterone, and estrogen in the serum of women was measured using a 120 Spin device from the Spinrest company, using ready-made kits specific to this device of Spanish origin.

Measuring the level of gonad nutrients

The concentration of FSH, LH, and prolactin in the women's serum was measured using the Maglumi800 device from Snaibe company through ready-made kits of German origin.

Measuring the level of urea and creatine

The concentration of urea and creatinine was measured using a 120 Spin device from the Spinrest company, using ready-made kits specific to this device of Spanish origin.

Statistical Analysis

The Statistical Analysis System- SAS (2018) program was used to detect the effect of difference groups (patients and control) in study parameters. T-test was used to significant compare between means in this study.

Results and discussion

Table No(1). Average ± standard error

Groups	Incidence rate (%)	T3 (ng/ml)	T4 (ng/ml)	TSH (µIL /ml)
The first group Healthy group (the control)		1.443 b ±.063 0	94.260 b 2.564±	2.150 b 0.143±
the second group (hypothyroidism)	%40	0.558 c 0.016±	45.923 c 1.626±	6.854 a 0.346±
The third group (hyperthyroidism)	%60	3.457 a 0.264 ±	145.640 a 4.163±	0.142 c 0.031±
LSD		0.415	8.180	0.728

Different letters indicate significant differences at the probability level ($p \leq 0.05$)

Table No (2). Average ± standard error

Groups	Progesterone ng/mL	Testosterone ng/mL	Estrogen ng/mL
The first group Healthy group the control)	b 1.178 ± 0.177	a 0.224 ± 0.041	a 70.040 ± 2.032
the second group (hypothyroidism)	b 0.676 ± 0.061	a 0.271 ± 0.078	b 46.584 ± 1.437
The third group (hyperthyroidism)	a 6.645 ± 0.622	a 0.436 ± 0.106	a 69.340 ± 2.001
LSD	0.991	0.234	5.203

Different letters indicate significant differences at the probability level ($p \leq 0.05$)

Table (3)
Average ± standard error

Groups	FSH mIU /mL	LH mIU /mL	Prolactin ng/mL
The first group Healthy group (the control)	b 4.568 ± 0.153	a 10.672 ±0.302	b 9.941 ±0.286
the second group (hypothyroidism)	a 6.570 ±0.368	a 11.729 ±2.577	a 16.476 ±0.514
The third group (hyperthyroidism)	b 5.304 ±0.458	b 4.590 ±0.75 8	a 15.360 ±0.796
LSD	1.040	5.305	1.654

Different letters indicate significant differences at the probability level ($p \leq 0.05$) .

Table (4). Average ± standard error

Standard Groups	Creatine mg/ dL	Urea mg/ Dl
The first group Healthy group (the control)	a 0.730 ±0.015	a 23.300 ±0.633
the second group (hypothyroidism)	a 0.753 ±0.024	a 25.769 ±1.549
The third group (hyperthyroidism)	a 0.680 ±0.038	a 23.500 ±0.957
LSD	0.08	3.336

Different letters indicate significant differences at the probability level ($p \leq 0.05$) .

Table (5)
Average ± standard error

Groups	Total protein mg/ dL	Glucose mg/ dL
The first group Healthy group	a 7.930 ±0.152	b 94.300 ±2.246

(the control)		
The second group (hypothyroidism)	b 7.546 ±0.207	c 88.461 ±1.824
The third group (hyperthyroidism)	c 7.300 ±0.264	a 98.300 ±2.773
LDS	0.236	2.613

Different letters indicate significant differences at the probability level ($p \leq 0.05$)

Concentrations of thyroid hormones T4, T3 and TSH

The results of the current study showed a significant decrease ($p \leq 0.05$) in the concentration of the hormone (T3, T4) in the second group (hypothyroidism) and a significant increase in the concentration of the hormone (TSH) in the second group when compared with the healthy group (control), and a significant increase ($p \leq 0.05$) in the concentration of the hormone (T3, T4) in the third group, and a significant decrease ($p \leq 0.05$) in the concentration of (TSH) in the third group when compared with the healthy group (control). It was also shown that there was a significant increase in the third group when compared with the second group when the probability level is mentioned in Table (1)**.**

A disorder in the thyroid gland may originally have resulted from a disorder in the pituitary gland, which controls the functions of the thyroid gland it's through the secretion of the hormone TSH, which stimulates the thyroid gland to secrete its hormones, which leads to stopping the rhythm of its harmony between it and the thyroid its, and thus Its secretion of the hormone increases or decreases. TSH) stimulates the production of thyroid hormones (T4, T3). This is what the results of our current study indicate, as it became clear that there was a significant increase in the concentration of (TSH). In the second group, with hypothyroidism and a significant decrease in TSH concentration. In the third group with hyperthyroidism, low levels of thyroid hormones in the blood are accompanied by high levels of TSH and vice versa, and this was confirmed by the study. of [5] and showed [6]. Indicated that a high increase in the level of TSH in the blood indicates a decrease in levels of Thyroid hormones: This is called hypothyroidism, as hypothyroidism depends on several factors, such as iodine supplements, age and gender. Ethnicity and antibody status in addition to other factors such as systolic blood pressure, body mass index, total cholesterol, smoking, erythrocyte sedimentation rate, and diabetes, there is a significant association between hypothyroidism and the prevalence of heart disease. On the other hand, the results of the study by [5] are identified as the results of our study, as it showed that an excessive secretion of thyroid hormones occurred when compared with the concentration of the TSH hormone, which indicates a decrease in the secretion of the pituitary gland, which may be the result of a defect in the pituitary gland, which led to an increase in the level and concentration of T3 and T4 hormones in the group. The third (hyperthyroidism) or hypothyroidism may be the result of a decrease in the supply of iodine in the daily diet, as iodine is considered one of the most important of these minerals that must be available in food, and the nutritional deficiency of minerals and vitamins such as iron, selenium, and vitamin D. It may cause hypothyroidism because it is deprived of the essential factor that contributes to making its hormones [6] indicated that if the daily iodine processing rate decreases to less than <25 µg, a person suffers from hypothyroidism, as 80% of people suffer from an enlarged thyroid gland in areas that suffer from a severe iodine Deficiency. On the other hand, the cause of a disorder in the thyroid gland may

be attributed to a disorder in the sex hormones such as progesterone and estrogen. Studies have indicated that there is a direct relationship between estrogen and thyroxine, as estrogen directly affects the thyroid gland, and any decrease in estrogen reflects negatively on the secretion of thyroxine from the thyroid gland. Thyroid glands to the point that a woman may suffer from hypothyroidism resulting from low estrogen concentration, and this explains the condition in many menopausal women, as he pointed out [7]. That women are diagnosed with thyroid disease through changes in hormone levels such as estrogen and progesterone, as estrogen is the hormone that enhances the function of the thyroid gland. If estrogen levels are low, the function of the thyroid gland also decreases, and this is one of the reasons. The main reason that causes many women to suffer from a disorder in the secretion of the thyroid gland is that, in rare cases, there is a decrease in the activities of thyroid hormones within the body's tissues, which leads to a decrease in the functional performance of the body. Sometimes the disorder or imbalance occurring in the thyroid gland is of two types. The first is abnormal activity of the immune system, as this system mistakenly attacks the cells of the thyroid gland, thus affecting its production of hormones and resulting in a decrease in the concentration of thyroxine within the body in the pathological condition known as thyroiditis. (Autoimmunity) The situation may be the opposite of what was previously mentioned, as a viral infection causes inflammation of the thyroid gland, resulting in that gland releasing its stores of the hormone thyroxine all at once into the blood, and this is what causes hyperthyroidism, as indicated by [8] indicated that infections may be a cause of hypothyroidism or hyper production. If the infections result from the immune system attacking thyroid cells, they cause hypothyroidism, but if they result from a viral infection, they cause hyperthyroidism. The second is that it may be a defect in the thyroid gland itself, which is considered a pathological condition characterized by a decrease in the secretion of thyroid hormones through blood, as he explained [6], as we have shown, the thyroid gland may become inflamed, which negatively affects its secretion of hormones, or the reason for this may be the thyroid gland's infection with Graves' disease, multi-nodular goiter, benign of tumor, etc., and this is consistent with the study [9] . Autoimmune diseases, genetic factors, and environmental factors, especially chemical pollutants, may also be a cause of thyroid disorder through their effect on thyroid tissue. It is known that (diethyl Hexyl (2- ethylhexyl phthalate (DEHP) is one of the chemical pollutants that cause... Pathological changes in the structure of the thyroid gland [10] . On the other hand, the use of some types of treatments may cause an imbalance in thyroid secretions [11] . showed that when amiodarone is used to treat arrhythmia, it causes a disturbance in thyroid secretions by reducing T3 production and increasing it slightly. In T4, the TSH concentration does not change in the Pathological condition called thyrotoxicosis resulting from amiodarone (ALT) (Amiodar in induced thyrotoxicosis [11].

The relationship between thyroid disorder and sex hormones

It was observed that there was a significant increase ($p \leq 0.05$) in the concentration of progesterone in the third group (hyperthyroidism). When compared with the first group (Healthy group) the control and (hypothyroidism), as for the concentration of testosterone, there was a significant increase in the third group when compared with the first and second groups. As for the concentration of estrogen, there was a significant increase in the second group when compared with the first group. The third is at the probability level mentioned in Table (2).

The results of the current study appear that there is a significant increase in progesterone in the third group (hyperthyroidism) and a significant decrease in estrogen concentration in the second group (hypothyroidism), in women, thyroid disorders are responsible for dysregulation of the hypothalamic-pituitary-gonadal axes and are associated with hypothyroidism with lack of menstruation [12].So the thyroid hormones are vital for the proper functioning of the female reproductive system, because they modify the metabolism and development of ovarian, uterine and placental tissues. Therefore, hypo- and hyperthyroidism can cause poor fertility or infertility in both women and animals [13] [14]. Furthermore, they act indirectly through multiple interactions with other hormones and growth factors, such as estrogen, prolactin (PRL), and insulin-like growth factor (IGF), and by influencing the release of gonadotropin-releasing hormone (GnRH). In the hypothalamic-pituitary axis and gonads [13] [14]. On the other hand, a disorder in the thyroid gland will lead to a disorder in sex hormones such as progesterone and estrogen. Studies have indicated that there is a direct relationship between estrogen and thyroxine, as estrogen directly affects the thyroid gland, and any decrease in estrogen reflects negatively on the secretion of thyroxine from the gland. Hypothyroidism to the point that a woman may suffer from hypothyroidism resulting from low estrogen concentration, and this explains the condition in many menopausal women, so any thyroid dysfunction can cause changes in the ovarian cycle as well as in ovulation [15] . Expression of T3 and T4 receptors in the uterine epithelium peaks in the middle of this secretory phase, while expression decreases in the secretory phase and is inversely proportional to the increase in progesterone [16].Women are diagnosed with thyroid disease through changes in hormone levels such as estrogen and progesterone, as estrogen is the hormone that improves thyroid function. If estrogen levels decrease, thyroid function also decreases, and this is one of the main reasons why many women suffer from a disorder in the secretion of the thyroid gland, and in rare cases, a decrease in its activities. Of thyroid hormones inside the body's tissues, leading to decreased functional performance of the body [15][17]. These results agree with the results of [15]and [18]. which showed that lower levels of E2 and T in women with hypothyroidism and the results don’t agree regarding testosterone concentration. The

results of our current study showed an increase in the hormone prolactin, which inhibits the hypothalamic-pituitary-gonadal axis and ovarian resistance to the action of gonadotropins, leading to amenorrhea and failure of ovulation, which leads to a decrease in estrogen, and this explains the results from our current study [19].

Relation of thyroid disorder with gonadotropins concentration in women.

The results of the current study showed that there was a significant increase($p \leq 0.05$) in the prolactin and FSH concentration in the second group (hypothyroidism) and prolactin in the third group compared with the healthy group (control). Also, there was a significant decrease in LH concentration in the third group when compared to the control group and there was a significant decrease in LH, FSH concentration in the third group when compared with the second group. Table (3). Changes in the menstrual cycle in women with hypothyroidism indicate that thyroid disorders are associated with ovarian hyperactivity, such as hyperestrogenemia, prolactinemia, and impaired fertility. It is believed that the effects of thyroid hormones on reproductive dysfunction are largely due to changes in the level of TSH, the secretion of which overlaps with FSH, LH, and prolactin [20]. And The prevalence of hyperprolactinemia is higher in primary hypothyroidism [21]. Prolonged hypothyroidism can lead to ovulatory dysfunction and hyperprolactinemiaHe pointed out [22] . indicated that the decrease in the concentration of (LH) may be due to the high concentration of the hormone prolactin, which works to inhibit the neurons in the hypothalamus that secrete (GnRH) and thus inhibit the secretion of (LH).

The relationship between thyroid disorder and kidney function in women

The results of the current study showed that there was no significant difference ($p \leq 0.05$) in the concentration of (creatine, urea) between the second group (hypothyroidism) and the third group (hyperthyroidism) when compared with the healthy group (control). It was also shown that there was no significant difference in the concentration of (Creatine, urea) in the third group when compared with the second group at the probability level mentioned in Table (5). The kidneys are not only an organ of thyroid hormone metabolism and disposal, but are also the target of some of its actions [23]. The thyroid gland plays an indispensable role in maintaining growth and metabolism in the renal system, as a decrease in the activity of the renal system is accompanied by a compensatory change in the level, synthesis and metabolism of thyroid hormones. The renal system is affected by cases of hypothyroidism in the body [24].

Thyroid hormones play an important role in the growth and development of various tissues, including the kidneys, which are the primary site of renin release and subsequent formation of angiotensin and aldosterone. Therefore, any disturbance in thyroid function can lead to abnormal functioning of the renin-angiotensin-aldosterone system [25]. Dysfunction of thyroid hormones causes marked changes

in the glomerular glomerulus. Tubular function, electrolyte balance, glomerular filtration, blood creatinine and a change in water excretion capacity [26]. Hypothyroidism and hyperthyroidism directly worsen renal function by affecting renal blood flow, glomerular filtration rate, and tubular levels, electrolyte balance, electrolyte pump function, kidney structure (e.g., decreased glomerular volume and area), and increased peripheral vascular resistance [27]. Thyroid dysfunction is also associated with glomerulonephritis, often a common autoimmune disease. Many medications can affect thyroid and kidney functions. There are a few interactions described between the thyroid gland and malignant renal tumors. Detailed knowledge of all these interactions is important for both nephrologists and endocrinologists [28] While [29] referred to overt hypothyroidism as associated with an increased risk of chronic kidney disease. The results of this study do not agree with [23] They showed that there is a significant increase in urea and creatinine levels in patients with hypothyroidism. Furthermore, increased serum creatinine has been associated with increased TSH levels in people with overt hypothyroidism.

The relationship between thyroid disorder and total protein and glucose in non-pregnant women

The results of the current study showed that there was no significant difference ($p \leq 0.05$) in the concentration of (total protein) in the second group (hypothyroidism) and the third group (hyperthyroidism) when compared to the healthy group (control). It was also shown that there was no significant difference in the second group when comparing it with the third group at the aforementioned probability level. The results of the current study also showed that there was a significant decrease ($P \leq 0.05$) in glucose concentration between the second group (hypothyroidism) and the healthy group (control). It was shown that there was no significant difference ($P \leq 0.05$) in the third group (hyperthyroidism) and the control group (healthy people). The results of the current study showed a significant increase in the third group when compared to the second group at the probability level mentioned in Table (5).

Studies have shown that there is a widespread correlation between diabetes and thyroid diseases, which are the most common glands disorders. He pointed out [26] Thyroid disorder is a condition that negatively affects glucose metabolism and is commonly found in diabetes. Diabetes appears to affect thyroid function in two stages. First, at the site of control of hypothalamic TSH release, and second, in the conversion of thyroid hormone to T3 in peripheral tissues. Thyroid hormones and insulin interfere with each other and affect the metabolism of the body's cells. Any change in one of them directly or indirectly affects the other. DM alters thyroid function by affecting both hypothalamic control of TSH production and conversion of T4 to T3 in peripheral tissues. Increased TSH concentration in diabetics may be a result of the medications they receive that suppress fT4 and

T4 concentrations, while increasing TSH levels. Another reason is insulin, which raises T4 levels while suppressing T3 concentration by inhibiting the liver. Conversion of T4 to T3, the third reason may be autoimmune diseases, and the fourth is the prevalence of thyroid antibodies in patients with diabetes. Furthermore, increased TSH concentrations in diabetes may be due to the presence of an inhibitor of thyroid hormone binding (inhibitor of T4 to T3 conversion), dysfunction of the hypothalamic-pituitary thyroid axis, and the effect of poor diabetes control on thyroid hormone concentration. Moreover, since TD and DM have a common autoimmune etiology, increased TSH in diabetic patients may be due to immunological alterations [30].also pointed out that Thyroid hormone affects glucose homeostasis by influencing the development of pancreatic beta cells and glucose metabolism through various organs such as the liver, digestive system, and pancreas, skeletal muscle, central nervous system and Adipose tissue. The results appeared that there was a significant increase in glucose concentration in the third group (hyperthyroidism) compared with the second group (hypothyroidism) and this agrees with [31] , who pointed out that Hyperthyroidism changes blood sugar control in diabetics, while Hypothyroidism increases susceptibility to hypoglycemia. Thus, complicating diabetes control, [32] Proteins in circulation are known to reflect an individual's physiology. In order to quickly identify important protein markers to determine thyroid disease status [33].

Conclusion

There are negative effects of thyroid disorders on physiological and biochemical parameters.

Reference

[1] N. Mikael and F. Henrik , " Development of the thyroid gland," Published by The Company of Biologists Ltd, vol. 144, no. 1, pp. 2123-2140, 2017.

[2] . K. Arun and O. Prabhakar , "Role of hypothyroidism and associated pathways in pregnancy and infertility: Clinical insights," Tzu Chi Medical Journal, vol. 32, no. 4, p. 312–317, 2020.

[3] D. Akif , G. Ali and O. Yusuf, "Fasting Blood Glucose Levels and Lipid Profile in Patients with Thyroid Dysfunction," Sch. J. App. Med. Sci, vol. 3, no. 3, pp. 1447-1449, 2015.

[4] . I. Shahid, K. S. Anil , A. Mushir , . N. Suryakant and A. Naved , "Hypothyroidism and Possible Association with Metabolic Syndrome," International Journal of Biomedical and Advance Research, vol. 7, no. 9, pp. 421-423, 2016.

[5] . X. Dong, . J. Dong, . Y. Zhao, J. Guo, . Z. Wang and M. Liu, "Effects of long-term in vivo exposure to di-2-ethylhexylphthalate on thyroid hormones and the TSH/ TSHR signaling pathways in wistar rats," International journal of environmental research and public health, vol. 14, no. 1, p. 44, 2017.

[6] . M. Udovcic, . R. H. Pena, . B. Patham, L. Tabatabai and . A. Kansara, "Hypothyroidism and the heart," Methodist DeBakey cardiovascular journal, vol. 13, no. 2, p. 55, 2017.

[7] M. Vander pump, "The epidemiology of thyroid diseases," Philadelphia, vol. 9, no. 1, pp. 469-398, 2005.

[8] . P. Subrat, D. P. . S. Ananya and . A. Das, "Analyzing thyroid dysfunction in the climacteric," J Mid-life Health, vol. 9, no. 1, pp. 113-16, 2018.

[9] G. Bereda, "Hyperthyroidism Definition, Causes, Pathophysiology and Management," Journal of Biomedical and Biological Sciences, vol. 1, no. 2, pp. 1-11, 2022.

[10] D. Xinwen and D. Jin , "Effects of Long-Term In Vivo Exposure toDi-2-Ethylhexylphthalate on Thyroid Hormones and

the TSH/TSHR Signaling Pathways in Wistar Rats," International journal of Environmental Researcg and Public Health, vol. 14, no. 1, pp. 1-14, 2017.

[11] M. O. Patricia and U. Maja , "HYPERTHYROIDISM AND THE HEART," debakey-journal, vol. 13, no. 2, pp. 60-63, 2017.

[12] Krassas GE, Poppe K and Glinoer D, "Thyroid function and human reproductive health," Endocr Rev , vol. 31, no. 1, pp. 702-55, 2010.

[13] . S. Juneo F, . O. Natalia M and Rogeria Serakides, "Thyroid hormones and female reproduction," Biology of Reproduction, vol. 99, no. 5, p. 907–921, 2018.

[14] Mintziori G, Kita M, Duntas L and Goulis DG, "Consequences of hyperthyroidism in male and female fertility: pathophysiology and current management," J Endocrinol Investigation , vol. 39, no. 8, p. 849–853, 2016.

[15] . S. Sanjay, S. . G. Bharti , . P. Rajeev, S. S. Kumar , . A. B. Sureshrao, A. Puspalata and . A. Pankaj , "Effect of hypothyroidism on female reproductive," Indian Journal of Endocrinology and Metabolism, vol. 20, no. 1, pp. 108-113, 2016.

[16] Vissenberg, Manders, Mastenbroek, E. Fliers, G. Afink, C. Ris-Stalpers, M. Goddijn and Bisschop4, "Pathophysiological aspects of thyroid hormone disorders/thyroid peroxidase autoantibodies and reproduction," Human Reproduction Update, vol. 21, no. 3, p. 378–387, 2015.

[17] . P. Subrat and D. P. Ananya , "Analyzing thyroid dysfunction in the climacteric," J Mid-life Health , vol. 9, no. 3, pp. 113-6, 2018.

[18] J. Minakshi , . B. Shradha and F. S. Mamta , "A REVIEW: MECHANISTIC INSIGHTS INTO THE EFFECT OF THYROID DISORDERS ON ESTROGEN LEVEL AND BONE MINERAL DENSITY," International Journal of Pharmacy and Pharmaceutical Sciences, vol. 11, no. 10, pp. 9-17 , 2019.

[19] Z. L. Renuka , . B. Shweta, L. R. Rajul Lodh and Biyani S, "Correlation of Thyroid Hormones with FSH, LH and Prolactin in Infertility in the Reproductive Age Group Women," IAIM, vol. 3, no. 5, pp. 146-150, 2016.

[20] T.Veeresh , D.Moulali and Sarma, "A study on serum FSH, LH and prolactin levels in women with thyroid disorders," International Journal of Scientific and Research Publication, vol. 5, no. 3, pp. 1-4, 2015.

[21] Sharma LK, Sharma N, Gadpayle AK and Dutta D, "Prevalence and predictors of hyperprolactinemia in subclinical hypothyroidism," Eur J Intern Med , vol. 35, no. 1, pp. 106-10, 2016.

[22] K. Arun and Prabhakar Orsu, "Role of hypothyroidism and associated pathways in pregnancy and," Tzu Chi Medical Journal, vol. 32, no. 4, p. 312–317, 2020.

[23] Vandana Saini, Amita Yadav, Megha Kataria Arora, Sarika Arora, Ritu Singh and Jayashree Bhattacharjee, "Correlation of creatinine with TSH levels in overt hypothyroidism — A requirement," Clinical Biochemistry, vol. 45, no. 1, pp. 212-214, 2012.

[24] . M. Gonella Geetha, "Renal Dysfunction in Hypothyroid Patients and Estimation of Blood Urea, Serum Creatinine, T3, T4 and TSH," International Journal of Contemporary Medical Research, vol. 3, no. 1, pp. 2915-2917, 2016.

[25] . F. Susan A. S and D. Kawa F, " Aliskiren, Fosinopril, and Their Outcome on Renin-Angiotensin-Aldosterone System (RAAS) in Rats with Thyroid Dysfunction," Hindawi International Journal of Endocrinology, vol. 10, no. 1, pp. 1-9, 2019.

[26] Mushir Ahmad, Anil Sharma , Shahid Iqbal, Suryakant Nagtilak and Naved Ahmad, "Renal Dysfunction in Hypothyroid Patients and Estimation of Blood Urea, Serum Creatinine, T3, T4 and TSH," International Journal of Contemporary Medical Research , vol. 3, no. 10, pp. 2915-2917, 2016 .

[27] Yi Chen , Wen Zhang, Ningjian Wang , Yuying Wang, Chiyu Wang, Heng Wan and Yingli Lu, "Thyroid Parameters and Kidney Disorder in Type 2 Diabetes Results from the METAL Study," Hindawi Journal of Diabetes Research, vol. 10, no. 1, pp. 1-11, 2020.

[28] Gopal Basu and Anjali Mohapatra, "Interactions between thyroid disorders and kidney disease," Indian Journal of Endocrinology and Metabolism , vol. 16, no. 2, pp. 204-213, 2012 .

[29] Zhang Y, Chang Y, Ryu S, Cho J, Lee WY, Rhee EJ, Kwon MJ, B. R. Pastor, Rampal S and Han WK, "Thyroid hormone

levels and incident chronic kidney disease in euthyroid individuals the Kangbuk Samsung Health Study.," International Journal of Epidemiology, vol. 43, no. 5, p. 1624–1632, 2014.

[30] . S. E. Young, W. Jessica R and . B. Victor J, "Links between Thyroid Disorders and Glucose Homeostasis," Diabetes Metab J , vol. 46, no. 1, pp. 239-256, 2022.

[31] . V. Uppal, . C. Vij, Bedi, A. Vij and Banerjee, "Thyroid disorders in patients of type 2 diabetes mellitus," Indian Journal of Clinical Biochemistry, vol. 28, no. 1, pp. 336-341, 2013.

[32] . S. . A. M. Mohammad, N. Nurun , S. S. Mohammad and M. . R. Mohammad , "hyroid Hormonal Status in Newly Diagnosed Type 2 Diabetes Mellitus," Bangladesh J. Nucl. Med, vol. 20, no. 1, pp. 27-31, 2017.

[33] Afshan Masood , B. Hicham , . E. Aishah A and A. Assim A, "Plasma-Based Proteomics Profiling of Patients with Hyperthyroidism after Antithyroid Treatment," Molecules, vol. 25, no. 10, pp. 1-18, 2020.