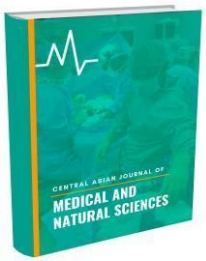

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Article

T4 and T3 Levels In Type 2 Diabetes Mellitus Patients In Kirkuk City

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Abstract: Diabetes mellitus, particularly type 2, is a rapidly growing chronic disease globally, with significant metabolic implications. Among the various complications associated with type 2 diabetes, thyroid dysfunction particularly hypothyroidism has been observed with increasing frequency, affecting hormonal regulation and glucose metabolism. Despite established connections between diabetes and thyroid disorders, localized clinical data from regions such as Kirkuk are limited, especially regarding the direct measurement of thyroid hormones T3 and T4 in diabetic patients. This study aimed to evaluate thyroid hormone (T3 and T4) levels in type 2 diabetic patients in Kirkuk city, identifying any significant deviations associated with hypothyroidism and assessing gender and age correlations. Blood samples from 68 individuals were classified into three groups: diabetic with hypothyroidism, diabetic only, and healthy controls. Results indicated a significant decrease ($p \leq 0.01$) in T3 and T4 levels in diabetic patients with hypothyroidism compared to the other groups, with the mean T3 at 80.04 ± 5.59 ng/dL and T4 at 5.35 ± 0.60 µg/dL. Thyroid dysfunction was notably higher among females, especially in the 45–55 age group.The study offers the first dataset correlating T3/T4 levels and diabetic status in Kirkuk, using stratified group analysis and robust biochemical testing. Implications: These findings emphasize the necessity for routine thyroid screening in type 2 diabetic patients to detect and manage hypothyroidism early, potentially mitigating further metabolic complications.

Keywords: T3, Thyroid hormones, T4, Insulin, Hypothyroidism

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1. Introduction

Diabetes is among the most common chronic illnesses nowadays. Statistics reveal a rising prevalence of type 2 diabetes in the Arab world, mostly attributed to obesity and lifestyle modifications. Thyroid hormones significantly influence glucose metabolism via many pathways. (Taher, 2024)Diabetes is categorised as insulin-dependent diabetes mellitus (IDDM) and non-insulin-dependent diabetes mellitus (NIDDM) [1].

The World Health Organisation estimates that 50% of individuals with type 2 diabetes remain undiagnosed. Diabetes is often identified accidentally during the diagnosis of other illnesses. This may result in severe consequences for those with diabetes, including loss of consciousness, irregular blood pressure, cardiovascular illness, visual impairments, and tissue necrosis (gangrene), perhaps necessitating amputation to prevent further dissemination to adjacent tissues.

Diabetes is a disorder marked by elevated blood glucose levels, arising from an impairment in the body's insulin synthesis and use. This may result in complications such

as damage to tiny blood vessels, causing retinopathy and ocular issues, renal disease, and cardiovascular disease [3].

Chronic hyperglycemia arises from either insufficient insulin synthesis by the pancreas (type 1 diabetes) or inadequate cellular responsiveness to insulin (type 2 diabetes). Thirst, frequent urination, impaired vision, and weight loss are signs of diabetes, sometimes obscured by pancreatic dysfunction resulting in inadequate insulin production [4].

Diabetes is among the foremost causes of mortality globally, with projections indicating that the figure will escalate to 600 million by 2040. In 2018, 415 million persons were diagnosed with diabetes, representing a fourfold rise from 2015.

Approximately 80% of individuals with diabetes reside in low-income nations in Asia, North America, and South America, where an estimated 10 million people are affected by the condition. The prevalence rate has reached 68% in comparison to other disorders. Numerous publications have shown a significant frequency of thyroid problems in individuals with type 2 diabetes, ranging from 0.2% to 6% [6].

Diabetes may be linked to thyroid gland dysfunction, situated in the central neck under the larynx. The thyroid gland synthesises two hormones: T3 and T4.

These hormones govern the body's utilisation and storage of energy (metabolism). The pituitary gland, situated in the brain, controls thyroid hormone activity by secreting thyroid-stimulating hormone (TSH), which prompts the thyroid to synthesise T3 and T4. Thyroid disorders increase in prevalence with advancing age.

The most prevalent condition is hypothyroidism, characterised by insufficient hormone production by the thyroid gland. Hypothyroidism is characterised by elevated levels of thyroid-stimulating hormone (TSH) and decreased levels of thyroxine (T4). Iodine deficiency is the primary cause of hypothyroidism globally; in regions with sufficient iodine, autoimmune thyroiditis (Hashimoto's thyroiditis) is the predominant cause.

The escalating worldwide obesity pandemic, attributed to inadequate nutrition, has adversely affected human health and contributed to a rise in the incidence of thyroid disease and diabetes. This results from several factors, including thyroid malfunction and autoimmune thyroid disease. Thyroid dysfunction, including hyperthyroidism and hypothyroidism, is among the most prevalent autoimmune disorders.

Thyroid illness is prevalent in diabetics and correlates with ageing. Diabetes and thyroid diseases exhibit interaction, wherein any thyroid malfunction adversely affects blood glucose levels and the well-being of individuals with diabetes [11].

Due to the systemic circulation of thyroid hormones in the bloodstream and their impact on several organs, hypothyroidism and hyperthyroidism are more prevalent in individuals with type 2 diabetes compared to those without the condition. These hormones influence glucose, fat, and protein metabolism, hence exacerbating diabetes complications [12].

Type 2 diabetes is characterised by diminished levels of the hormone TSH, which obstructs the conversion of T4 to T3 in peripheral tissues. Consequently, the manifestations of the illness emerge. Diabetes is linked to hypothyroidism, which impacts the body's metabolism and disrupts the glycolytic pathway in cells. Thyroid hormones impede insulin's function, which degrades glycogen and promotes gluconeogenesis. Thyroid issues are more prevalent in older women (ages 40 to 60) compared to males, influenced by psychological and lifestyle variables [13].

2. Materials and Methods

Sample Collection: During November 2024, (68) random blood samples were collected from Kirkuk hospitals. Blood glucose levels in the random samples were

measured using a 500-nm spectrophotometer. Thyroid hormone levels were also measured using a diagnostic kit manufactured by Mindray (China The total number of random samples was 68. After screening using diabetes screening tests and thyroid hormone screening tests, we confirmed the presence of 20 samples from diabetic patients with hypothyroidism, 38 from diabetic patients alone, and 10 from healthy controls [14].

The normal ranges for this study were:

T3: 70-200 ng/dL , T4: 4.8-12.5 μg/dL , TSH: 0.4-4.0 μIU/ml

Blood glucose: 70-120 mg/dL

3. Results and Discussion

The study began by taking 68 random samples, 75% of which were males (number 51) and 25% females (number 17) (Figure 1). This is consistent with the results of other studies, such as and. The results of both studies showed that the percentage of women with diabetes accompanied by thyroid dysfunction is higher than that of men, see Figure 1 [15].

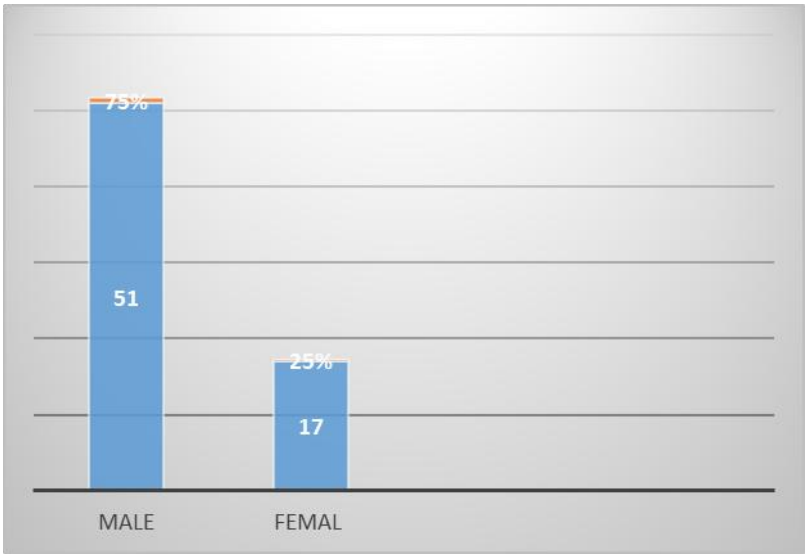

Figure 1. A chart showing the ratio of males to females

The samples were categorised into three groups for comparative analysis: the first group (G1) included 20 persons with diabetes and hypothyroidism, the second group (G2) consisted of 38 individuals with diabetes alone, and the third group (G3) contained 10 healthy individuals. Figure 2. In 68 samples, 38% of individuals had thyroid abnormalities associated with diabetes. Diabetes constituted just 50% of the total. Figure 1 illustrates the distribution of diabetes and thyroid diseases by gender, revealing that the largest percentage (59%) was seen in females with both conditions. Conversely, just 29% of men had thyroid issues linked to type 2 diabetes. This finding is also consistent with the results of Thyroid disorders are less common in men, due to the interaction between estrogen and progesterone and thyroid hormones in women, see Figure 2 [16].

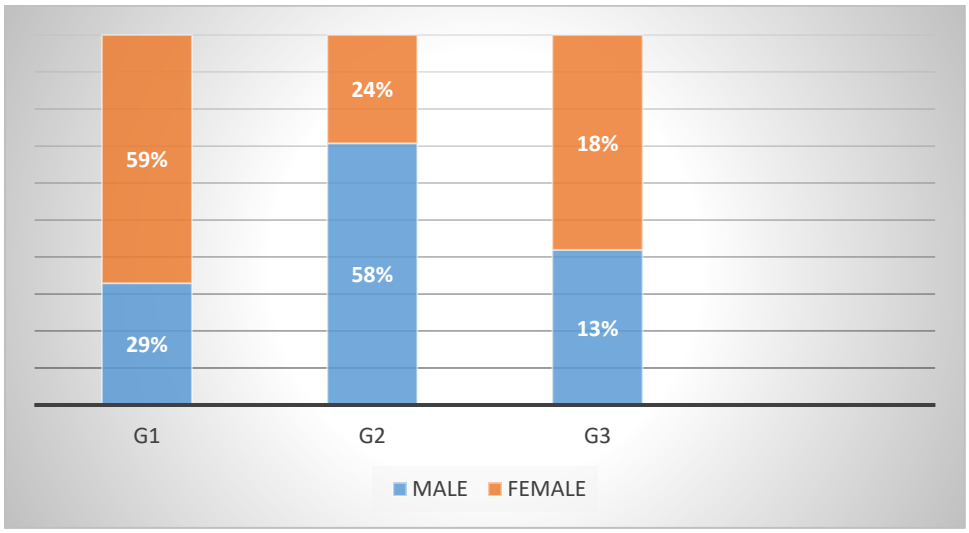

Figure 2.

Random samples showed the highest incidence of diabetes with thyroid dysfunction in the 45-55 age group, which we attributed to advanced age, nutritional status, and the approaching menopause in women, which affects hormones. The highest incidence of diabetes was recorded in the 55-65 age group, which we attributed to advanced age and impaired insulin production, see Figure 3 [17].

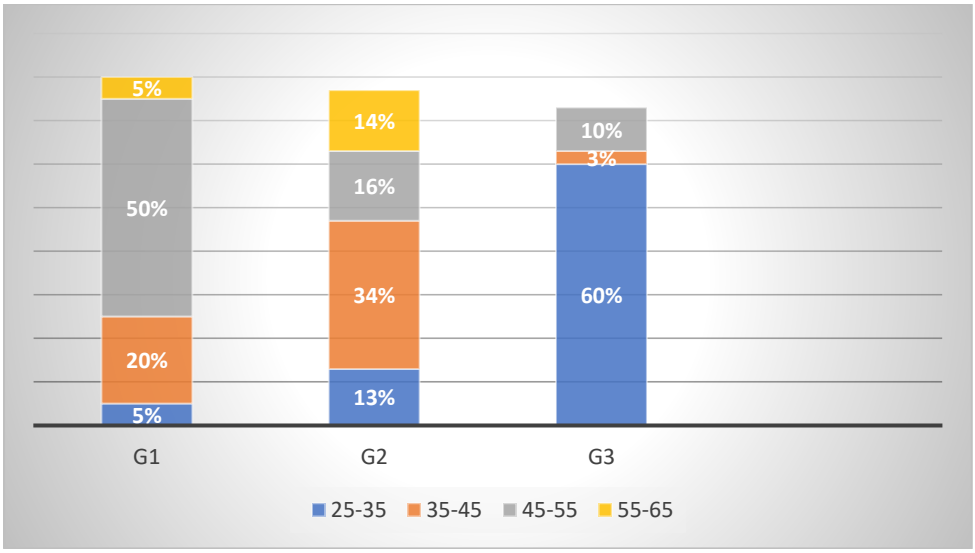

Figure 3. Age group ratios for each of the three groups

We used analysis of variance (ANOVA) and the LSD test to assess significance at $p < 0.05$ and $p < 0.01$. Diabetic individuals with hypothyroidism indicated reduced T3 concentrations in comparison to the G2 and G1 groups (Figure 4). Moreover, no substantial change ($p < 0.01$) was seen between G2 and G3. The average T3 concentration in G1 was (80.04 ± 5.59 ng/dL), in G2 it was (130.80 ± 9.02 ng/dL), and in G3 it was (150.10 ± 8.99 ng/dL). These results may be explained by the fact that most patients with hypothyroidism suffer from impaired insulin secretion and insulin resistance, see Figure 4 [18].

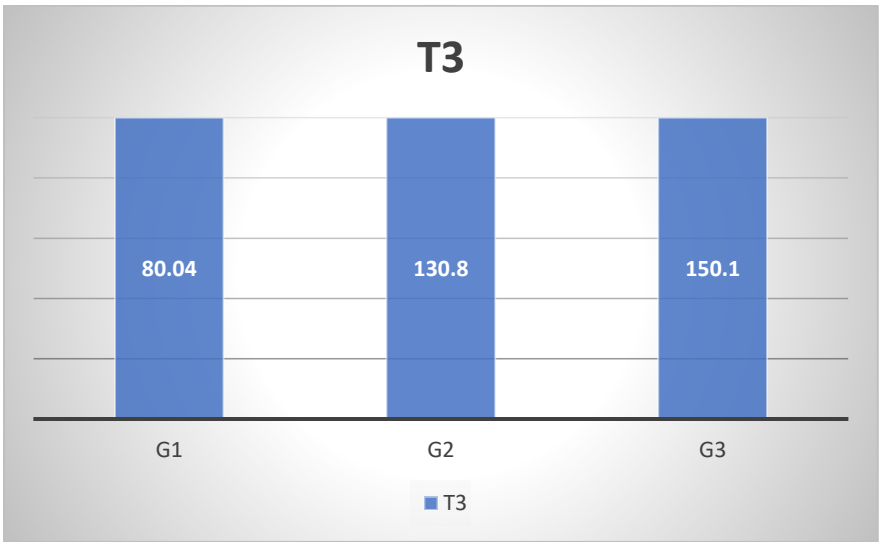

Figure 4. T3 level in groups

In addition, there was a significant decrease ($p \leq 0.01$) in mean T4 levels (G1) compared to G2 and G3. There was no significant difference ($p > 0.01$) between G2 and G3. The mean T4 level in diabetic patients with hypothyroidism in G1 was 5.35 ± 0.60 µg/dL, while it was 8.98 ± 0.72 µg/dL in G2 and 10.99 ± 0.31 µg/dL in G3 (Figure 5). Thyroid function appears to be affected by diabetes at the peripheral tissue level, where thyroid hormone T4 is converted to T3 [19].

As a result, diabetes can lead to changes in thyroid hormone levels due to metabolic problems and its impact on the thyroid gland, which is responsible for producing hormones that regulate the body's metabolism. Diabetics may also have a thyroid problem, preventing normal blood sugar control. The impact of diabetes on thyroid function may be unclear, potentially leading to hypothyroidism and decreased hormone levels, see Figure 5 [20].

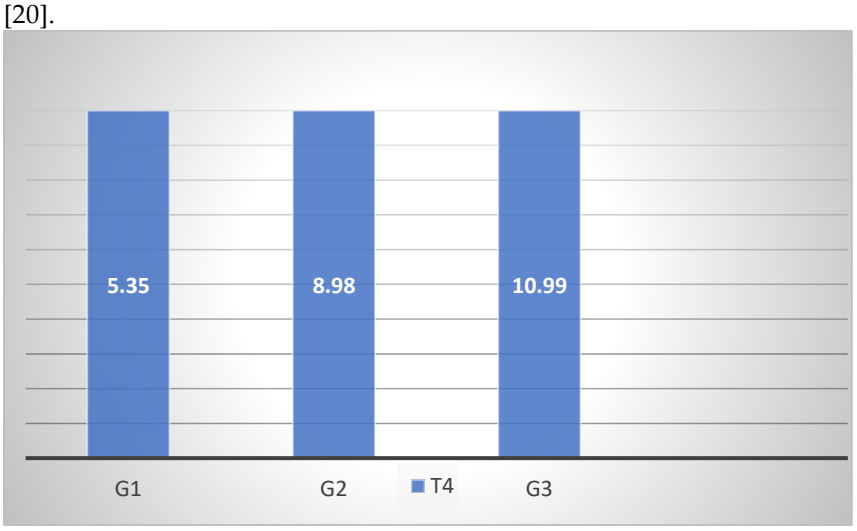

Figure 5. T4 level in groups

4. Conclusion

This study demonstrates a significant association between thyroid dysfunction—particularly hypothyroidism—and type 2 diabetes mellitus among patients in Kirkuk city. The findings revealed notably decreased levels of T3 and T4 hormones in diabetic individuals with hypothyroidism compared to diabetic-only and healthy control groups. Furthermore, the prevalence of thyroid dysfunction was higher among females, particularly in the 45–55 age group, highlighting the influence of hormonal and physiological changes during this stage of life. These outcomes underscore the metabolic

interdependence between thyroid and pancreatic functions, where impaired thyroid activity may exacerbate insulin resistance and glycemic instability. Therefore, regular screening for thyroid hormone levels in diabetic patients is recommended for early detection and management of thyroid-related complications. This proactive approach could enhance overall treatment outcomes and reduce the risk of long-term metabolic disorders.

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