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# Evaluation of Growth Hormone, Insulin, and Antibodies in Children with Thyroid Disorders, in Al-Rifai Region /Iraq

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**Abstract**

The study aims to determine the relationship between thyroid disorders and the concentration of growth hormone, insulin, antibodies (TPO, Tg, TRAb) and CBC in children. The study sample was divided into three groups: control group, hypothyroidism group and hyperthyroidism group. The parameters were measured according to the special Kits. The results showed a significant increase in the concentrations of insulin, GH, Anti-TPO, Anti-TRAb, Anti-Tg and MPV in the second and third groups compared with control group. Also, there is a significant increase in number of WBC, LYM, MCHC, MPV, and PDWa in the second group compared with third and control groups and there is a significant decrease in MID in the second and third groups compared with first group, while a significant decrease in GRA, MCV, HGB, HCT, PLT in the second group compared with third and control groups. There is a significant increase in PCT level in the third group compared with second group. This study showed an apparent relationship between thyroid disorders and the studies parameters.

**Keywords**: Thyroid disorders, Hyperthyroidism, Hypothyroidism, Growth hormone, Insulin.

# تقييم هرمون النمو والأنسولين والأجسام المضادة لدى الأطفال المصابين باضطرابات الغدة الدرقية في منطقة الرفاعي/العراق

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**الخلاصة**

تهدف الدراسة إلى تحديد العلاقة بين اضطرابات الغدة الدرقية وتركيز هرمون النمو والأنسولين والأجسام المضادة (TPO, Tg, TRAb) وتعداد الدم الكامل لدى الأطفال. قُسِّمت عينة الدراسة إلى ثلاث مجموعات: المجموعة الضابطة، ومجموعة قصور الغدة الدرقية، ومجموعة فرط نشاط الغدة الدرقية. وقُيست المؤشرات باستخدام أدوات خاصة. أظهرت النتائج زيادةً معنوية في تراكيز الأنسولين، وهرمون النمو، ومضادات TPO ، ومضادات TRAb ، ومضادات Tg ، و MPV في المجموعتين الثانية والثالثة مقارنةً بالمجموعة الضابطة. كما توجد زيادةٌ معنوية في عدد خلايا الدم البيضاء، وLYM، وMCHC، وMPV، و PDWa في المجموعة الثانية مقارنةً بالمجموعتين الثالثة والضابطة. كما يوجد انخفاضٌ معنوي في MID في المجموعتين الثانية والثالثة مقارنةً بالمجموعة الأولى، وانخفاضٌ معنوي فيGRA ، وMCV، وHGB، وHCT، و PLT في المجموعة الثانية مقارنةً بالمجموعتين الثالثة والضابطة. كما توجد زيادةٌ معنوية في مستوى PCT في المجموعة الثالثة مقارنةً بالمجموعة الثانية. بينت الدراسة الحالية وجود علاقةٌ واضحةٌ بين اضطرابات الغدة الدرقية ومؤشرات الدراسة.

**الكلمات المفتاحية:** أضطرابات الغدة الدرقية، فرط نشاط الغدة الدرقية، قصور الغدة الدرقية، هرمون النمو، الانسولين.

## 1. Introduction

Thyroid disorders are considered the second most prevalent metabolic conditions in the world, after diabetes. The prevalence rates of thyroid disorders in various parts of the world are influenced by a number of factors, including biological and geographic variations [1]. Thyroid hormone disorders are defined according to their levels: hypothyroidism at low levels and hyperthyroidism at high levels [2]. Hypothyroidism is characterized by an abnormal decline in thyroid hormone levels, which can be caused by the gland or inadequate hypothalamic-pituitary axis activation. It is one of the most common thyroid disorders worldwide, and its occurrence increases in accordance to the global population [3].

Hypothyroidism can cause symptoms such as fatigue, cold intolerance, non-puberty, unexplained weight gain, and delayed growth. Its prevalence rate varies from 0.2 to 5.3% in Europe and from 0.3 to 3.7% in the United States. Furthermore, the development of hypothyroidism is impacted by numerous factors such as genetic differences, drugs, infections, environmental factors, diseases or tumors or some therapies, and nutrition [4].

Hyperthyroidism is characterized by high levels of thyroid hormones in tissues as a result of increased thyroid hormone production and secretion [5]. Toxic multinodular goiter, toxic adenoma, Graves' disease (GD), and painless thyroiditis are the most common causes of Hyperthyroidism in the United States [6]. Hyperthyroidism accounts for around 15% of thyroid diseases in children, with the majority of instances related to autoimmune hyperthyroidism [7]. The development of the disease frequently occurs between the ages of 20 to 50, and it is more common in women in the case of GD, whereas in patients with toxic adenoma, the disease is more common in adults over 50 years old [8]. Growth is a complex process that involves the interaction of a set of factors such as nutritional, genetic, and hormonal variables [9].

The balance of thyroid hormones is essential to stimulate the appropriate response to these factors by promoting the secretion of growth hormone (GH), thyrotropin-releasing hormone (TRH), and growth-hormone-releasing hormone (GHRH). In addition to the presence of various external stimulants for the growth process and its balance, these include exercise, malnutrition, and acute or chronic disorders [10].

Both hyperthyroidism and hypothyroidism can cause a decrease in glucose utilization in skeletal muscles or an increase in glucose production in the liver, leading to the development of insulin resistance (IR). But the effect of thyroid hormones on the development of insulin resistance and the onset of Type 2 diabetes Mellitus (T2DM) remains unclear according to many recent studies [11]. Thyroid hormones have an effect on autoimmune illnesses, which are defined by organ inflammation caused by the development of antibodies against the body's own structures and the impact of toxic T cells. Antibodies to thyroid peroxidase (TPO), thyroglobulin (Tg), and the thyroid-stimulating hormone receptor (TSHR), also known as thyrotropin receptor antibody (TRAb), have been commonly observed in autoimmune thyroid diseases [12].

**Objective:** The study aimed to determine the relationship between thyroid disease and the concentration of growth hormone, insulin hormone, antibodies (TPO, Tg, TRAb), and the complete blood count in blood samples of the affected patients.

## 2. Methods

### *2.1. Collecting blood samples and methods*

Sample collection for this study requires a period of time from August 4 to November 30, 2024. Blood samples were collected using a sterile, single-use syringe to withdraw 5 ml of blood from the median cubital vein of females aged 1 to 15 years. The blood sample was then divided into two tubes: 3 ml of blood in a serum separating tube (SST) and 2 ml in an ethylenediaminetetraacetic acid (EDTA) tube. The SST tube was then centrifuged for 5 minutes at 3000 rpm after being left at room temperature for 7 minutes to allow the blood to clot. The resulting serum was collected into microtubes and stored in a freezer at -20°C for measuring thyroid hormones and antibodies by using an El Maglumi 800 from the Snaibe company, while blood in an EDTA tube was used for measuring a complete blood count (CBC) by using an Auto Hematology Analyzer from the Mindray company.

*2.2 Statistical analysis*

Statistical analysis was performed by SPSS version 27. The results were expressed as mean ± standard deviations (mean ± SD). One-way ANOVA was used to compare parameters in different studied groups. P-value ($P \leq 0.05$) was considered statistically significant.

## 3. Results and discussion

### *3.1. Impact of thyroid disorders on insulin and growth hormone.*

The results of the current study showed a significant increase in the concentrations of insulin (INS) and growth hormone (GH) in the second group (hypothyroidism) and the third group (hyperthyroidism) when compared with control group, ($p \leq 0.05$), Table (1).

**Table 1-** Impact of thyroid disorders on insulin and growth hormone levels (mean ± SD)

| Groups / Parameters | Group 1 (Control group) | Group 2 (hypothyroidism) | Group 3 (hyperthyroidism) |
|---|---|---|---|
| Insulin hormone (μIU/ml) | 10.866 b ±2.118 | 14.862 a ±3.173 | 16.000 a ±2.159 |
| growth hormone (ng/ml) | 1.196 c ±1.199 | 4.666 a ±1.392 | 2.579 b ±1.163 |

**The different letters refer to a significant difference at (P≤ 0.05).**

The increase in insulin concentration in patients with thyroid disorders may be caused by increased resistance of the cells to insulin, which causes an increase in its secretion in additional quantities to regulate glucose in the bloodstream, or there may be an increase in fats, which causes an increase in insulin secretion and a decrease in its metabolism in the liver [13]. As shown by Brenta, 2011, that the thyroid hormones operate as both insulin agonists and antagonists in various organs. However, this occurs in the delicate balance required for optimal glucose metabolism. A lack or excess of thyroid hormones can disrupt this balance, resulting in changes in glucose metabolism. Both hypothyroidism and hyperthyroidism have been linked to glucose intolerance and ketoacidosis [14]. Gierach *et al.,* 2014 has indicated that TSH concentrations are associated with insulin resistance, as

thyroid hormones have known effects on carbohydrate metabolism, including insulin resistance, which results from hyperthyroidism, or an increase in insulin resistance may be associated with liver problems [15]. According to study by Eom *et al.,* 2022, thyroid hormones also directly stimulate insulin secretion by pancreatic β-cells, and increases glucagon release by pancreatic α-cells. Hyperthyroidism increases glucose transporter type 4 (GLUT4) gene expression and glucose uptake in skeletal muscles [16]. In a study conducted by Rajalakshmi & Begam, 2021, pointed out that hyperthyroidism can cause increased in the body's metabolism, which may lead to an increased need for insulin. However, the body may increase insulin production to counteract the increased insulin resistance that may result from increased thyroid hormones [17]. The current results are consistent with the results of a cross-sectional study conducted by Garduño-Garcia *et al.,* 2015, that demonstrated a strong significant association between insulin and thyroid hormones [18]. In addition, our current findings are consistent with the results of a cross-sectional study that demonstrated significantly higher blood insulin levels in children and adolescents in the second group compared with control group [19] .Conversely, our study results do not agree with those of Aktar Karakaya *et al.,* 2025, which showed no significant association between insulin and thyroid hormones in all participants (patients and healthy) [20]. In the same vein, our study results do not agree with those of Singh *et al.,* 2010, that showed insulin concentration is significantly increased in the hyperthyroid group compared to the hypothyroid group. The reason for this increase is that insulin resistance is positively correlated with TSH and negatively correlated in the hyperthyroid group as a result of different mechanisms such as altered insulin secretion and lipid levels [21].

Regarding growth hormone, Tarım showed in 2011 that the reason for the increase in GH secretion in patients with thyroid disorders is the presence of a deficiency in blood sugar, that results from increased insulin [22]. Also, Behan *et al.,* 2011 pointed out that the thyroid gland plays an important role in regulating the metabolism in the body, including regulating blood sugar levels. Hypothyroidism causes a slowdown in the metabolism, which causes a decrease in blood sugar levels, or the reason for the increase in GH may be the presence of an enlarged thyroid gland [23]. In the same vein, Kucharska *et al.,* 2021 showed the presence of a positive correlation between an enlarged thyroid gland and an increase in GH in patients with thyroid gland suffering from acromegaly [24]. Also, Leung & Brent, 201, have indicated that hypothyroidism particularly in children, can lead to increased GH secretion as the body's response to compensate for the lack of thyroid hormones. However, the effect of GH may be ineffective due to a lack of thyroid hormones necessary for normal growth. Hypothyroidism may also affect the hypothalamic-pituitary-thyroid axis, which may lead to changes in growth hormone levels [10]. In hyperthyroidism, metabolism can increase significantly, which can affect GH levels. However, the relationship between hyperthyroidism and GH isn't always straightforward and may vary from person to person [25]. So our results were inconsistent with those of Cammisa *et al.,* 2024, in which the GH were significantly lower in the second group when compared with third and control group [26]. In addition, our study does not agree with the results of a prospective study that found the children with hypothyroidism were diagnosed with low GH concentrations despite receiving GH therapy [27].

### *3.2. impact of thyroid disorders on antibody*

The current results indicated a significant increase in the levels of Anti-TPO**,** Anti-TRAb and Anti-Tg levels in the second group (hypothyroidism) and the third group (hyperthyroidism) when compared with control group, and a significant increase in the third group when compared with second group at a $P \leq 0.05$, Table (2).

**Table 2-** Impact of thyroid disorders on antibody concentration (mean ± SD)

| Groups / Parameters | Group 1 (Control group) | Group 2 (hypothyroidism) | Group 3 (hyperthyroidism) |
|---|---|---|---|
| anti-thyroid peroxidase (TPO) (IU/ml) | 2.653 c ±1.024 | 4.745 b ±1.058 | 8.684 a ±1.276 |
| anti-TSH receptor antibodies (TRAb) (IU/ml) | 0 .866 b ±0.301 | 2.043 a ±0.866 | 2.271 a ±0.994 |
| anti-thyroglobulin (Tg) (ng/ml) | 10.850 c ±2.279 | 24.987 b ±2.783 | 32.105 a ±3.052 |

**The different letters refer to a significant difference at (P≤ 0.05).**

Abdullah *et al.*, 2022, have pointed out that anti-TRAb, anti-TPO, and anti-Tg have established associations with thyroid autoimmune diseases. Thyroid receptor antibodies can be subdivided into TSH receptor-stimulating (TSAbs), TSH receptor-blocking (TBAbs), and neutral thyroid receptor (N-TRAbs). TSAbs are typical antibodies in GD that can bind and activate TSH receptors, causing increased thyroid hormone production. TBAbs bind to TSH receptors without causing activation and prevent TSH binding to the TSH receptor, resulting in hypothyroidism. N-TRABs do not block the binding of TSH to the TSH receptor, but they are able to induce local infiltration of inflammatory cells into the thyroid gland and eyes. Thyroid peroxidase (TPO) serves as the core enzyme during the synthesis of thyroid hormones. Elevated TPOAb level is essential in diagnosing Hashimoto's thyroiditis and supportive in the work-up of GD. Anti-Tg is mainly composed of IgG and mainly attacks different antigenic determinants of thyroglobulin. Anti-TPO and anti-Tg are frequently present in the same individual. [28]. As shown by Lindgren *et al.*, 2019, the triggering of an autoimmune response in GD is determined by genetic background and environmental factors, which result in the production of stimulating TRAb and activation of TSH receptors in thyroid follicular cells, followed by increased thyroid hormone release, resulting in thyrotoxicosis [29]. Our current results are consistent with the results of the reference study by Malandrini *et al.*, 2022, which indicated a significant increase in anti-TPO and anti-Tg levels in the second group compared to the third and the control group[30]. In the same context, our results are match with the results of a cross-sectional study conducted by Taubner *et al.*, 2014. This study found that the prevalence of anti-TPO and anti-Tg is age-dependent, with their values increasing in the first year of life and during puberty, but with increased concentrations in the second and third groups [31]. In contrast, the current results did not match with those of the reference study, which showed no significant correlation between anti-TRAb levels in patients with thyroid disorders compared to the control group. In contrast, anti-TPO and anti-TG levels showed a slight increase in patients with thyroid disorders compared to the control group [32].

### *3.3. Impact of thyroid disorders on total and differential count of WBC*

The results of the current study showed a significant increase in the number of white blood cells (WBC) and the number of lymphocytes (LYM %) in the second group when compared with third group and control group. However, the results showed a significant decrease in the mid-sized white blood cells (MID %) in the second and third groups when compared with control group.

Additionally, the results indicated a significant decrease in the number Granulocytes (GRA%) in the second group when compared with control group at a significance level ≤0.05, Table (3).

**Table 3-** Impact of thyroid disorders on total and differential count of WBC

| Groups / Parameters | Group 1 (Control group) | Group 2 (hypothyroidism) | Group 3 (hyperthyroidism) |
|---|---|---|---|
| White blood cells (WBC) (10^9/L) | 8.566 b ±1.116 | 13.414 a ±4.568 | 7.144 b ±0.908 |
| Lymphocytes (LYM) (%) | 3.016 c ±0.402 | 5.700 a ±1.157 | 4.455 b ±0.665 |
| mid-sized white blood cells (MID) (%) | 10.783 a ±1.282 | 6.642 c ±1.561 | 8.100 b ±1.176 |
| Granulocytes (GRA) (%) | 54.783 a ±9.808 | 48.114 ab ±10.255 | 44.488 b ±6.316 |

**The different letters refer to a significant difference at (P≤ 0.05).**

High white blood cell count can be linked to several causes. It may be the result of infection or inflammation, or due to the body's reaction to certain factors. Thyroid disorders may be one of these factors, as they affect the immune system [33]. As Chmielewski & Strzelec, 2018, pointed out that the thyroid gland plays an important role in regulating metabolism and the immune system. Thyroid disorders such as hyperthyroidism or hypothyroidism may affect the immune system and increase the body's sensitivity to inflammation and infection, which may cause an increase in the number of white blood cells. Also, an increased level of lymphocytes or lymphocytosis may be associated with thyroid diseases, especially in the case of lymphocytic thyroiditis (such as Hashimoto's disease), as an increase in lymphocytes may be an indicator of the presence of infection or chronic inflammation in the body and may also be associated with diseases of the immune system [34]. The reason for the decrease in blood parameters in patients with thyroid disorders may be due to antithyroid drugs (ATDs). A study by Watanabe *et al.,* 2012, showed that antithyroid drugs can cause hypoplasia of white blood cells, including granulocytes, with pancytopenia, which causes changes in blood composition [35]. Also, a study by Gotera *et al.,* 2023, showed that antithyroid drugs cause a decrease in neutrophils through the path of agranulocytosis [36]. The results of our study do not match those of a cross-sectional study conducted by Dorgalaleh *et al.,* 2013, where this study found no correlation between the WBC between the second and third groups when compared to the control group [37]. Conversely, our results are match with those of a cross-sectional study conducted by Munteanu *et al.,* 2024,This study showed a significant increase in neutrophil and LYM [38].

### *3.4. Impact of thyroid disorders on red blood cells (RBC) and their parameters*

The results of the current study showed no significant differences in the number of red blood cells (RBC), red cell distribution width (RDWa), red blood cell distribution percentage (RDW %), and mean corpuscular hemoglobin (MCH) between the second group and the third group when compared with control group. The results also showed a significant decrease in the mean corpuscular volume

(MCV), hemoglobin (HGB), and hematocrit (HCT%) in the second group when compared with third group and control group. Additionally, the results also showed a significant increase in the mean corpuscular hemoglobin concentration (MCHC) in the second group when compared with third group and control group at a significance level ≤0.05, Table (4).

**Table 4-** Impact of thyroid disorders on R.B.C. and their parameters (mean ± SD)

| Groups / Parameters | Group 1 (Control group) | Group 2 (hypothyroidism) | Group 3 (hyperthyroidism) |
|---|---|---|---|
| Red Blood Cells (RBC) (10^12/L) | 4.330 a ±0.409 | 4.730 a ± 0.248 | 4.407 a ±0.832 |
| Mean corpuscular volume( MCV) (fL) | 83.900 a ±7.775 | 86.314 a ±4.215 | 71.600 b ±9.206 |
| Hematocrit (HCT) (%) | 36.016 a ±2.916 | 38.757 a ±5.899 | 30.166 b ±5.100 |
| Red Cells Distribution Width (RDWa") (fL) | 43.750 a ±2.356 | 42.842 a ±6.242 | 41.588 a ±10.497 |
| Red Cells Distribution Width (R DW) (%) | 13.950 a ±2.843 | 13.285 a ±1.903 | 13.666 a ±1.304 |
| Hemoglobin (HGB) (g/dL) | 11.416 ab ±1.014 | 11.912 a ±0.874 | 10.822 b ±0.641 |
| Mean Corpuscular Hemoglobin (MCH) (Pg) | 26.533 a ±2.936 | 29.025 a ±1.476 | 27.544 a ±7.323 |
| Mean Corpuscular Hemoglobin Concentration (MCHC) (g/dL) | 31.666 b ±0.816 | 34.287 ab ±1.016 | 38.222 a ±7.747 |

**The different letters refer to a significant difference at (P≤ 0.05).**

Thyroid hormones stimulate the proliferation of red blood cell precursors directly and by enhancing erythropoietin production, whereas iron deficiency anemia negatively affects thyroid hormone status. Thus, various forms of anemia may develop in the context of thyroid dysfunction. Normocytic anemia is the most common, whereas macrocytic or microcytic anemia occurs less frequently. Anemia in hypothyroidism may result from bone marrow suppression, decreased erythropoietin production, comorbidities, or concomitant iron, vitamin B12, or folic acid deficiencies. Impaired iron metabolism and oxidative stress may contribute to anemia in hyperthyroidism. The risk of anemia in autoimmune thyroid disease (AITD) may be associated with pernicious anemia, atrophic gastritis, celiac disease, autoimmune hemolytic syndrome, or rheumatic disorders. The coexistence of anemia with thyroid disease poses an important clinical problem [39]. The results of our study are inconsistent with those of the study by Rezk *et al.*, 2022, in which the analysis of the obtained data showed statistically

significant differences between the second and third groups in the RBC and RDW. However, they are consistent with the results of our study, in that there were statistically significant differences in the concentrations of MCH, MCHC, MCH, and HCT. Thyroid hormones play a crucial role in the metabolism and proliferation of blood cells. Thyroid dysfunction causes various effects on blood cells, such as anemia, erythropoiesis, and, in rare cases, pancytopenia. It also alters red blood cell indices, including MCV, MCH, MCHC, and RDW [40]. Also, the data analysis of Dorgalaleh *et al.*, 2013 study showed a statistically significant association between the second and third groups in terms of RBC, MCH and RDW and this data does not match the results of our study, but our results are consistent with this study in terms of the association between MCHC and HCT [37]. In the same context, our study does not match the results of the study conducted by Olt *et al.*, 2016, which showed an increase in RDW values that was linked to hypothyroidism, in contrast to the results of our study which concluded that there was no link between RDW and hypothyroidism [41].

### *3.5. Impact of thyroid disorders on platelet parameters*

The results of the study showed a significant decrease in the platelet count (PLT) in the second group when compared with third group and control group. The results also indicated a significant increase in the mean platelet volume (MPV) in the second group and the third group patients when compared with control group, as well as a significant increase in the Platelet Distribution Width (PDWa) in the second group when compared with third group and control group. The current results showed a significant increase in the procalcitonin (PCT%) level in the third group compared with second group, and the current results also indicated no significant differences in the percentage of larger platelet cells (P-LCR%) at a probability level ≤0.05, Table (5).

**Table 5**- Impact of thyroid disorders on platelet parameters (mean ± SD**)**

| Groups / Parameters | Group 1 (Control group) | Group 2 (hypothyroidism) | Group 3 (hyperthyroidism) |
|---|---|---|---|
| Platelet count (PLT) (10^9/L) | 378.166 a ±45.287 | 311.625 b ±50.891 | 426.111 a ±67.813 |
| Mean platelet volume (MPV) (fL) | 7.383 b ±0.727 | 9.062 a ± 0.462 | 8.788 a ±0.763 |
| Platelet Distribution Width (PDWa") (fL) | 9.716 b ±1.108 | 12.537 a ±2.070 | 9.900 b ±0.543 |
| Plateletcrit (PCT") (%) | 0.278 ab ±0.123 | 0.237 b ±0.017 | 0.325 a ±0.084 |
| Platelet large cell ratio (P-LCR" )(%) | 14.266 a ±2.628 | 16.612 a ±1.635 | 16.711 a ±2.965 |

**The different letters refer to a significant difference at (P≤ 0.05).**

Thyroid disorders may be associated with certain conditions that affect platelet counts, such as autoimmune diseases. Hypothyroidism can lead to changes in the function of certain organs, most notably the bone marrow, which may affect platelet production in the body. In some cases, hypothyroidism may cause a low platelet count due to its impact on metabolism and blood formation.

Also, hypothyroidism may lead to changes in liver function, which may affect the production of thrombopoietin, a hormone essential for platelet production. Hypothyroidism may lead to an enlarged spleen, which may trap platelets and reduce their number in the blood [42]. According to study by Erge *et al.*, 2023, increased platelet counts, or thrombocytosis, in thyroid disorders can be attributed to several factors, primarily related to thyroid hormone's influence on bone marrow and inflammation. In hyperthyroidism, thyroid hormones can stimulate platelet production because thyroid hormones (T3 and T4) can directly affect bone marrow, where blood cells, including platelets, are produced, while in Hashimoto's thyroiditis, an inflammatory condition, platelet production may also be increased due to inflammatory pathways [43]. The results of our study are disagree with a prospective study conducted at the Department of Clinical Pathology, Al-Azhar University Hospitals, Cairo, Egypt. This study found that PLT had no significant association in the second and third groups of patients [40]. In addition, the results of our study are inconsistent with the study conducted by Ahmed & Mohammed, 2020, which concluded that thyroid dysfunction affects all blood tests except for platelets, in which no association was found. The thyroid gland plays a crucial role in blood formation, and blood disorders are frequently observed in patients with thyroid disorders. Thyroid hormones directly affect blood parameters by stimulating red blood cells to form and indirectly by enhancing the production of erythropoietin [44]. In the same context, the results of our study are inconsistent with the study conducted by Berta *et al.*, 2024, at the University of Gondar Comprehensive Specialized Hospital, northwest Ethiopia, which found an increase in platelets in the third group of patients [45]. The results of our study are consistent with the results of the study conducted by Erikci *et al.*, 2009, where hypothyroid patients showed higher values of MPV and PDW compared to the control group because MPV and PDW play an important prognostic role in hypothyroidism [46]. Also, the results of our study are agree with the results of the study conducted by Saran, 2019), in terms of the presence of a statistically significant increase in MPV and PDW and the absence of a statistically significant difference in PLCR. However, on the other hand, the results of the current study are not consistent with our results in terms of the absence of statistically significant values in the PLT and PCT in patients with hypothyroidism [42].

## 4. Conclusion

There is an apparent and reciprocal relationship between thyroid disorders and insulin, GH, Anti-TPO**,** Anti-TRAb, Anti-Tg, and CBC.

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