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Evaluation of the correlation and levels of vitamin B12, Zinc, and magnesium in people with thyroid disorders.

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Abstract :

Thyroid hormones are essential for normal growth and regulation of metabolic processes in adults. Thyroid disorders are ranked as the second most common endocrine disorder after diabetes. Although there were previous observational studies that dealt with the relationship between vitamin B12 and thyroid disease, their results were mixed, and the causal relationship between them was not clearly established. Vitamin B12, zinc, and magnesium significantly contribute to the support of thyroid functions and the regulation of its vital pathways. This study aims to evaluate the levels of these elements in blood serum in individuals with thyroid disorders, with the aim of exploring their potential role in the development of the disease or its response to treatment. **Material and Methods:** The study included 90 women between the ages of 18 and 60, and they were divided into three groups: the control group, all of whom were in good health, a group with hyperthyroidism, and a group with hypothyroidism. Samples were collected from government and private laboratories in Anbar Governorate. Levels of B12, zinc and magnesium were measured for all groups. The data were analyzed using appropriate statistical methods to evaluate differences between groups. **Results:** The results showed that the average vitamin B12 level was highest in the hyperthyroid group, while it was lowest in the hypothyroid group. Although B12 levels were higher in the hyperthyroidism group compared to the hypothyroidism group and the control group, this difference did not reach the level of statistical significance (P=0.072). A negative non-statistically significant relationship was also found between the level of B12 and TSH, and a positive non-statistically significant relationship between B12 and both T3 and T4. It was also found that the magnesium level was significantly higher in the hyperthyroidism group compared to the other two groups, and the difference was statistically significant ($P < 0.05$). Zinc levels were also higher in the hyperthyroidism group compared to the hypothyroidism group and the control group, but without any statistically significant differences. **Conclusion:** The study showed a significant increase in magnesium levels in women with hyperthyroidism compared to the hypothyroidism group and the control group. Higher levels of vitamin B12 were also observed, higher in the hyperthyroidism group and lower in the hypothyroidism group compared to the control group. However, these differences were not statistically significant.

Keywords: hyperthyroidism, hypothyroidism, B12, magnesium, zinc.

تقييم العلاقة الارتباطية ومستويات فيتامين B12 وعناصر الزنك والمغنيسيوم لدى الأشخاص الذين يعانون من اضطراب الغدة الدرقية.

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مستخلص:

تُعد هرمونات الغدة الدرقية اساسية للنمو الطبيعي ولتنظيم عمليات التمثيل الغذائي لدى البالغين. وتُصنف اضطرابات الغدة الدرقية كثاني أكثر اضطرابات الغدد الصماء شيوعاً بعد مرض السكري. وعلى الرغم من وجود دراسات رصدية سابقة تناولت العلاقة بين فيتامين B12 وأمراض الغدة الدرقية، الا ان نتائجها كانت متباينة، ولم تُحسم العلاقة السببية بينهما بشكل واضح. وبالنظر الى الأدوار الحيوية التي يؤديها كل من فيتامين B12، والزنك، والمغنيسيوم في دعم وظائف الغدة الدرقية وتنظيم مساراتها الحيوية. تهدف هذه الدراسة الى تقييم مستويات هذه العناصر في مصل الدم لدى الافراد المصابين باضطرابات الغدة الدرقية، بهدف استكشاف دورها المحتمل في تطور المرض او استجابته للعلاج. **المواد والطرق**: شملت الدراسة 90 امرأة تتراوح اعمارهن بين 18 و60 عاماً، وتم تقسيمهن الى ثلاث مجموعات: المجموعة الضابطة، وجميعهن يتمتعن بصحة جيدة، ومجموعة مصابات بفرط نشاط الغدة الدرقية، ومجموعة مصابات بقصور الغدة الدرقية. تم جمع العينات من المختبرات الحكومية والخاصة في محافظة الانبار. تم قياس مستويات B12 والزنك والمغنيسيوم لجميع المجموعات. وقد تم تحليل البيانات باستخدام الأساليب الإحصائية المناسبة لتقييم الفروقات بين المجموعات. **النتائج**: أظهرت النتائج أن متوسط مستوى فيتامين B12 كان الأعلى في مجموعة فرط نشاط الغدة الدرقية، في حين كان الأدنى في مجموعة قصور الغدة الدرقية. وعلى الرغم من أن مستويات B12 كانت أعلى في مجموعة فرط نشاط الغدة الدرقية مقارنة بمجموعة قصور الغدة الدرقية والمجموعة الضابطة، إلا ان هذا الفرق لم يصل الى مستوى الدلالة الإحصائية (P=0.072) . كما تم العثور على علاقة سلبية غير دالة إحصائياً بين مستوى B12 وهرمون TSH، وعلاقة إيجابية غير دالة إحصائياً بين B12 وكل من T3 وT4. كما وجد ان مستوى المغنيسيوم كان اعلى بشكل ملحوظ في مجموعة فرط نشاط الغدة الدرقية مقارنة بالمجموعتين الأخريين، وقد كان الفرق ذا دلالة إحصائية ($P<0.05$) . اما مستويات الزنك فقد كانت ايضاً أعلى في مجموعة فرط نشاط الغدة الدرقية مقارنة بمجموعة قصور الغدة الدرقية والمجموعة الضابطة، ولكن دون وجود فروق ذات دلالة إحصائية. **الاستنتاج**: أظهرت الدراسة وجود ارتفاع معنوي في مستويات المغنيسيوم لدى النساء المصابات بفرط نشاط الغدة الدرقية مقارنة مع مجموعة قصور الغدة الدرقية والمجموعة الضابطة، كما لوحظت مستويات أعلى من فيتامين B12 أعلى في مجموعة فرط نشاط الغدة الدرقية وأدنى في مجموعة قصور الغدة الدرقية مقارنة بالمجموعة الضابطة، إلا ان هذه الفروق لم تكن ذات دلالة إحصائية.

الكلمات المفتاحية: فرط نشاط الغدة الدرقية، قصور الغدة الدرقية، فيتامين B12، المغنيسيوم، الزنك.

Introduction

The thyroid is one of the glands of the endocrine system, located at the front bottom of the neck, directly below the throat. The two joints that form this gland communicate with each other through the isthmus, a small bridge of tissue. The thyroid gland grows during pregnancy, often larger in women than in men[1]. It plays an important role in children's natural body development and controls body metabolism, temperature regulation, fat demolition, proteins, and carbohydrates[2, 3]. There are two types of cells that are constituents of the thyroid gland. The first are follicular cells, which are responsible for the production of thyroid hormones. These cells contain a substance known as colloid, which includes a diabetic protein called thyroglobulin (Tg), which is central to the formation of the tertiary hormones triiodothyronine (T3) and tetraiodothyronine (T4), also known as thyroxine.

And the second are Parafollicular cells (C cells), which release the hormone calcitonin, which contributes to the regulation of calcium levels in the blood [4]. Thyroid also contains thyronine and tyrosine iodine compounds, which are reverse triiodothyronine (3,3,5 RT3) and 3-monoiodotyrosine (MIT) and (3,5-diiodotyrosine) (DIT) [5]. Thyroid hormones have an important role in development, growth, and cellular metabolism[6] ; hence, thyroid illnesses primarily impact various organ systems. Because the thyroid is responsible for a variety of processes [7], including digestive function and adrenal hormone metabolism, the most prevalent cause of obesity [8] and diabetes [9] also influences chemical changes in the brain. This produces dwarfism in infants and neonates, and thyroid gland malfunction can induce clinical symptoms throughout the body [10], since autoimmune disorders are caused by a mix of hereditary and environmental factors. [11] The term primary thyroid illness refers to abnormalities that arise from the thyroid gland itself, whereas secondary thyroid disease relates to central disorders induced by the anterior pituitary gland that have an indirect influence on thyroid function [12]. Thyroid diseases are the most prevalent endocrine issue. Vitamin B12, commonly known as cobalamin [13], has a highly complicated structure and is the biggest

vitamin. In the center of the corrin ring is a cobalt atom, the body's lone active component. Vitamin B12 is exclusively produced by anaerobic microbes [14]. Humans rely only on animal-derived foods, such as fish, meat, poultry, dairy products, and eggs [13]. Vitamin B12 has no inherent active forms in plant sources [15]; its bioavailability is determined by an individual's capacity to absorb it in the digestive system. Cobalamin is absorbed by two mechanisms: active and negative. Vitamin B12 is excreted in bile and reabsorbed by ileal receptors in the hepatocultural circulation. This procedure necessitates an internal element. Malignant anemia is caused by insufficient internal components, and excess vitamin B12 is excreted in the urine. Vitamin B12 aids in the production of myelin in the central nervous system, nucleic acid synthesis, and erythropoiesis [16]. Lessness of vitamin B12 is commonly seen in the elderly, vegetarians, pregnant women, and plant lactants, and vitamin B12 deficiency is caused by malabsorption [17]. Some drugs, such as protein pump inhibitors, metformin, nitrous oxide anesthesia, epilepsy medication, and colchicine, lead to vitamin B12 deficiency [18.19]. Vitamin B12 deficiency leads to manifestations of blood diseases[20], neurological diseases[21, 22], heart disease, blood vessels, and psychiatric diseases[23].

Materials and Methods

Sample collection

Sampling began in early October 2024 and continued until the end of January 2025. Blood samples were obtained from 90 women: 30 with hyperthyroidism, 30 with hypothyroidism, and 30 from the control group. Women involved in the research ranged in age from 18 to 60. Samples were collected from government and private laboratories in Anbar governorate. Five ml of intravenous blood was pulled from each person using a plastic syringe. After fasting for ten hours. The sample was then placed in a gel tube and left until it reached room temperature. The serum was then disconnected in a centrifuge for 10 minutes at a speed of 3000 rpm. Divide the serum in half and keep it in a specimen collection container at -40 ° C for further inspection.

Methods

Vitamin B12 levels in serum were measured using a B12 kit equipped

by the Chinese company snibe. vitamin B12 assay is a competitive chemiluminescence immunoassay. the sample, diluent, and buffer are added and incubated; then add ABEL labeled with vitamin B12-binding-protein, incubate, and form immune complexes; then add magnetic microbeads coated with purified vitamin B12 antigen and incubate. Vitamin B12 present in the sample competes with vitamin B12 immobilized on the magnetic microbeads for a limited number of binding sites on the ABEI-labeled vitamin B12-binding protein. After precipitated in a magnetic field, decant the supernatant, and repeat the wash cycle. The started 1+2 is then added to commence the flash chemiluminescent process. A photomultiplier measures the light signal as relative light units (RLUs), which are inversely proportional to the sample's vitamin B12 content. Based on the technique of measuring color using 5-bromo-PAPS, the amount of zinc in the serum has been estimated using the spectrum for quantification and diagnosis of zinc in the lab's blood serum. Zinc interacts with compound 2- (5-bromo-2-peridelazo) -5- (N-Propyl-N-sulfopropylamino) -phenol to form a red-colored concealed complex. The absorption intensity resulting from this reaction can be measured, as it corresponds expressly to the total concentration of zinc in the sample. The magnesium level in serum was tested using an AGAPPE kit. This detector is designed for the quantitative measurement of magnesium in serum in the laboratory. Magnesium reacts with a blue xylidyl detector in the center of an alkaline component of a color composite, and the resulting color intensity is expressly proportional to the amount of magnesium found in the sample.

Analysis of Statistics

SPSS 22 and Microsoft Excel 2019 were utilized for data entry and analysis. The features of the subjects were explained using descriptive statistics, which were displayed as frequencies. The t-test and Chi-Square test were used to compare the research groups. A statistically significant P-value is one that is less than 0.05.

Results

The total number of participants was 90 women: 30 with hyperthyroidism, 30 with hypothyroidism, and 30

healthy (control group). Women in the study ranged in age from 18 to 60. This study showed that the average level of vitamin B12 was higher in the group with hyperthyroidism and lower in the group with hypothyroidism without statistically significant differences. The average level of B12 was in the hyperthyroidism group (531 ± 430), in the control group (480 ± 105), and in the hypothyroidism group (377 ± 69). The average magnesium level was significantly higher in the hyperthyroidism group than in the hypothyroidism group (P<0.05). Zinc recorded unimportant differences (P=0.127). As shown in table1.

Table1. Comparison of B12 level and metabolic parameters of patient groups

Parameters	Mean ± SD			P-value
	Hyperthyroidism	Hypothyroidism	Control	
B12	430 ± 531	69 ± 377	105 ± 480	P=0.072
Mg	0.071 ± 2.01	0.081 1.95±	0.059 ± 1.99	P=0.016
Zn	22.86 ± 98.1	13.65 ± 89.4	10.13 ± 94.3	P=0.127

It has been found that with increased TSH levels, B12 levels have decreased. A negative relationship was found without statistically significant differences between B12 and TSH levels. When T3 and T4 levels increase, B12 levels increase. A statistically significant positive relationship was also found between magnesium levels and T3 and T4 (P<0.001) levels and a negative relationship without statistically significant differences between magnesium levels and TSH levels. While he found a negative relationship with zinc and TSH levels, he found a positive relationship between zinc levels and T3 and T4 levels without statistically significant differences. As shown in table 2.

Table 2. Correlation between TSH, T3, T4 levels and other parameters

		T3	T4	TSH
B12	r	0.157	0.193	-0.140
	p	p>0.05	p>0.05	p>0.05
Mg	r	0.306	0.305	-0.140
	p	p<0.001	p<0.001	p>0.05
Zn	r	0.198	0.201	-0.122
	p	p>0.05	p>0.05	p>0.05

Discussion

Despite the abundance of studies, the relationship between hypothyroidism and vitamin B12 deficiency remains controversial among researchers. Although some previous studies have shown an association between hypothyroidism and vitamin B12 [24] deficiency, this association is uncertain, as other studies have not been able to establish a clear relationship between them [25]. Our results showed a slight difference in average vitamin B12 levels between the groups with hypothyroidism, hyperthyroidism, and the control group. These findings are largely consistent with previous studies, such as Libby et al., which did not record statistically significant differences in vitamin B12 levels in serum. A recent study also found similar findings, with no significant differences in vitamin B12 levels observed between healthy individuals and patients with hypothyroidism [26], which supports our findings in this study. In contrast to the results of our study, some studies reported high vitamin B12 deficiency rates in hypothyroidism patients; Jabbar et al. [24] found that 40.5% of these patients had a deficiency in this vitamin. Aktash's study [27] reported that 46% of patients with hypothyroidism suffer from vitamin B12 deficiency. Differences in vitamin B12 deficiency rates among hypothyroidism patients, as reported in previous studies, are explained by different nutritional factors in patients, as well as the use of varying reference values in laboratories to identify deficiencies. Although some studies support routine testing for vitamin B12 deficiency in hypothyroidism patients [27], our results do not support the routine adoption of this procedure. This is in line with the British Commission's recommendation for criteria that do not support routine vitamin B12 screening for unlimited symptoms that do not require objective criteria [28]. The current study showed that the average magnesium level was significantly lower in the hypothyroidism group compared to the hyperthyroidism group, and statistically significant differences were not observed in the magnesium level between the hyperthyroidism group and the control group. In addition, the results revealed a positive correlation between magnesium concentration and levels of both T3 and T4, as opposed

to a negative correlation with TSH levels. This is consistent with the findings of the Mane et al. [29] study, which indicated that there were no marked changes in magnesium levels in serum in hyperthyroidic patients compared to the control group. This result is consistent with the results of our study, and may be attributed to low nutritional intake of magnesium in hyperthyroid patients. However, the current result contradicts previous reports, such as a study conducted by Suneel and others [30] that showed a significant increase in serum magnesium levels compared to controls. A study conducted by Dr. Turanjanin and others [31] in 2024 reported lower levels of magnesium in hypothyroidism patients than in the control group, and this is in line with the results of our study that showed a lower level of magnesium in hypothyroidism patients than in controls. A study conducted by Bushra and others [32] provides contradictory results, showing an increase in magnesium levels in hypothyroidism patients compared to the control group. This variation may be the result of, inter alia, differing categories of patients, their food intake and regional differences in mineral availability, or nutritional magnesium intake by hypothyroidism patients. The results also showed a positive relationship between magnesium and T3 and T4 and a negative association between TSH and magnesium, which may be due to the significant impact of the thyroid gland on magnesium levels. In our study, the levels of zinc in serum were higher in the hyperthyroidism group compared to the control group and the hypothyroidism group and were lower in the hypothyroidism group compared to the control group, but the differences were not statistically significant. Borawska and others point out that the level of zinc in serum in people with hypothyroidism is low and may result from inadequate intake of zinc in the diet [33]. Nishi et al. [34] did not observe a statistically significant difference in blood serum zinc concentrations between hypothyroidism patients and the control group, nor did they record any correlation between zinc levels and thyroid function. By contrast, Yoshida et al. [35] in 1990 showed a decrease in blood serum zinc levels in hypothyroidism patients compared to the control group, suggesting that this decrease may be due to poor gastrointestinal zinc

uptake in these patients. Many reports also showed that zinc deficiency was associated with lower levels of thyroid hormones. [36], although low zinc levels are associated with low thyroid hormone levels, the biochemical basis for these changes has not yet been determined [36].

Conclusions

In our study, the average vitamin B12 level was unremarkably low and had no statistical significance in patients with hypothyroidism compared to hyperthyroidism and the control group. We believe that routine testing to detect vitamin B12 deficiency in these patients is unwarranted unless there are clinical indications that call into question the existence of such deficiency. Future studies on larger population samples are also needed to verify the role of other indicators that may be associated with vitamin B12 deficiency. The average magnesium level was much greater in the hyperthyroidism group compared to the hypothyroidism group, and there was a statistically significant positive correlation between magnesium levels and T3 and T4 levels and a negative relationship without statistically significant differences between magnesium and TSH levels. Zinc recorded insignificant differences between aggregates. With larger sample size studies and long-term follow-up in the future.

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