

# THE RELATIONSHIP BETWEEN VITAMIN D<sub>3</sub> LEVELS AND HYPOTHYROIDISM

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## ABSTRACT

### *Background*

It has been well observed that vitamin D deficiency may increase the prevalence of hypothyroidism. However, there is little information on the relationship between vitamin D levels and thyroid diseases amongst the Kurdish population.

### *Objectives*

To find an association between thyroid function parameters and levels of Vit. D among two different groups.

### *Patients and Methods*

A case-control study was employed; two groups participated in the study, the first group was healthy individuals, and the other group was those with hypothyroidism.

### *Results*

The results of 90 persons were collected in the recent study. The mean age was  $42.76 \pm 9.47$ . The majority of the participants were women (52.2%). Vitamin D levels were deficient in most participants (50%), which means lower than 20.1 ng/ ml. Only about 37% of the participants had an average level of Vit. D.

### *Conclusion*

Deficiency in Vitamin D<sub>3</sub> is significantly associated with all thyroid function parameters.

**Keywords:** *Relationship, Vitamin D<sub>3</sub>, and Hypothyroidism.*

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## INTRODUCTION

It has been estimated that approximately one billion people have deficient or insufficient 25-hydroxy vitamin D concentration in their bodies<sup>(1)</sup>. Vitamin D is a fat-soluble vitamin and works as a prohormone. It is an essential vitamin that contributes to various human body functions. Therefore, enough circulating concentrations of 25-hydroxy vitamin D must be maintained<sup>(2)</sup>. Its deficiency in the body may negatively affect different health disorders, such as calcium homeostasis and osteoporosis, with possible roles in diabetes, cancer, ischemic heart disease, and autoimmune and infectious diseases<sup>(3,4)</sup>. In addition, scientific evidence has already shown that vitamin D deficiency and insufficiency are associated with higher secondary hyperparathyroidism-related serum Parathyroid Hormone (PTH)<sup>(5)</sup>. It has been also well observed that a high prevalence of vitamin D deficiency in children and adolescents may increase the prevalence of hypothyroidism and cause child obesity<sup>(6)</sup>. Analyzing the relationship between early-life risk factors for vitamin D and thyroid diseases can help understand the underlying mechanisms and carry out action-oriented interventions for several chronic diseases' primary and secondary prevention measures<sup>(7)</sup>. According to a study conducted in Iraq, females with below-normal vitamin D levels during their reproductive age may face infertility, miscarriage, and gynecologic problems<sup>(8)</sup>. However, there is insufficient evidence available on the relationship between vitamin D levels and thyroid disorders among the Kurdish population. Thus, this study aims to observe the relationship between vitamin D deficiencies and serum thyroid profiles.

## PATIENTS AND METHODS

### *Design, setting, and duration of study*

A case-control study was employed to conduct this study. The data were collected at three outpatient clinic Centers in Erbil: Runahi centre, Huzeri, and King lab from November 5, 2020, to January 15, 2021.

### *Distribution of study samples*

Ninety (90) subjects were included in the current study. Oral consent was taken from patients; after they agreed, they were recruited into the study. They were classified into two groups: Group I, the "control group", including 50 healthy individuals; standard clinical examinations; not complaining of any chronic

medical diseases; no history of thyroid diseases or any chronic disease that could interfere with our results. They have not used vitamin D supplements. Group II, "Hypothyroid patients", included 40 patients. They were diagnosed as hypothyroid patients if the TSH level was elevated. A more than five ng/ml value indicates the thyroid gland's principal inability. In addition, they had a lower T3 and T4 than the normal range. Deficiency in Vitamin D was defined "as a serum level of 25 OHD of  $<=20$  ng/ml and insufficiency as a serum level between 20-30 ng/ml"<sup>(9)</sup>. Blood samples were collected, and serum concentrations of thyroid parameters (TSH, T3, and T4) and Vitamin D were determined.

### *Data Analysis*

The collected data were inserted into Statistical Package for the Social Science (SPSS 20). The significant level of p-value started at below 0.05. The mean for all the variables was calculated, and differences between mean values for each tested variable were calculated by an independent t-test. The correlations between serum Vit. D and TSH were presented by correlation coefficient (r2).

## RESULTS

Ninety persons were enrolled in this study. The mean ( $\pm$ SD) of age was 42.76 ( $\pm$  9.47), and 52% were female. Regarding the level of vitamin D, about half of the participants were deficient (50%), the concentration of Vit D was lower than 20.1 ng/ml, while insufficient was about (12.2%), and (37.8%) of the patients had a normal level of Vit. D. In terms of thyroid function level, more than half of them (55.6%) had normal function level, while (44.4%) had hypothyroidism (Table 1). All the patients in group one with hypothyroidism were deficient in vitamin D. In contrast, most other groups with normal thyroid function levels had an average level of Vit. D, at about (68%). Additionally, there were significant differences between both groups regarding Vit D deficiency and all other thyroid function tests; T3, T4, and TSH, Table 2. Regarding the association between the thyroid function tests and the level of vitamin D, as explained in Figures (1), (2), and (3), there was a linear relationship between thyroid function tests and Vit. D observed; that there was an association between increasing TSH levels with decreasing Vit D levels figure (1). In addition, there was an association between T3 and T4 and Vit. D. in which increasing T3 and T4 levels increase the Vit D level. The Pearson's correlation coefficient between Vit

## The Relationship Between Vitamin D<sub>3</sub> Levels and Hypothyroidism

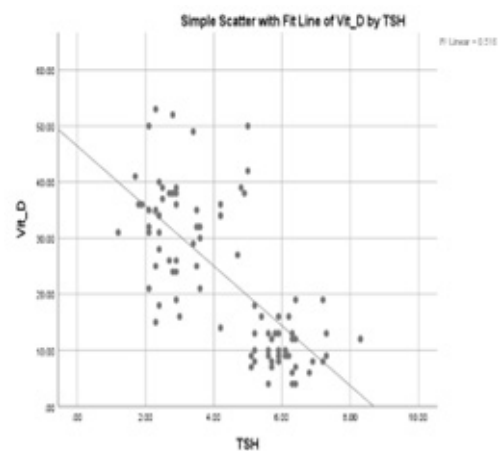
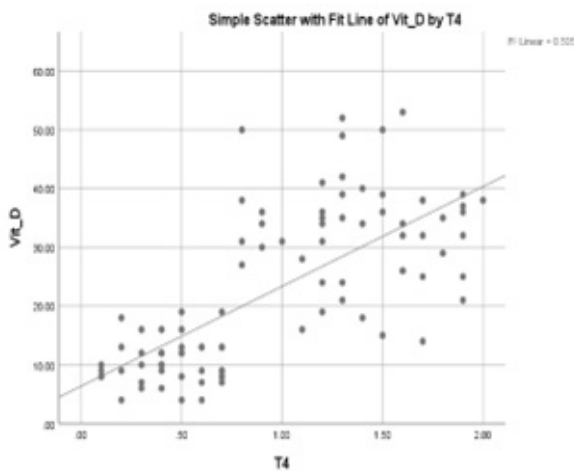
D and the tests of thyroid functions. R squared for vitamin D is accounted for by T4, and 46% is increasing TSH showed that 51% of vitamin level deficiency is Vit. D accounted for by T3 (Table 3). responsible for TSH; additionally, 50% of increasing

**Table 1. The baseline characteristics of the participants.**

Variables	Frequency	(%)
<b>Mean of Age (± SD)</b>	<b>42.76 (± 9.47)</b>	
<b>Gender</b>		
<b>Male</b>	43	47.8
<b>Female</b>	47	52.2
<b>Thyroid Function level</b>		
<b>Normal</b>	50	55.6
<b>Hypothyroidism</b>	40	44.4
<b>Vitamin D level</b>		
<b>Deficient</b>	45	50
<b>Insufficient</b>	11	12.2
<b>Normal</b>	34	37.8

**Table 2. Univariate analysis between groups of study.**

Variables	Group 1	Group2	P-value
<b>Vit D3</b>			
<b>Deficiency</b>	5 (10%)	100%	< 0.001
<b>Insufficient</b>	11 (22%)	0 (0%)	
<b>Normal</b>	34 (68%)	0 (0%)	
<b>Mean (±SD) of Vit. D</b>	32.9 ± 9.2	10.52 ± 3.88	< 0.001
<b>Mean (±SD) of TSH</b>	2.98 ± 0.92	6.14 ± 0.78	< 0.001
<b>Mean (±SD) T4</b>	1.4 ± 0.34	0.44 ± 0.19	< 0.001
<b>Mean (±SD) T3</b>	2.1 ± 0.87	0.52 ± 0.24	< 0.001



**Figure 1. The correlation between TSH and Vit. D. Figure 2. The correlation between T4 and Vit. D.**

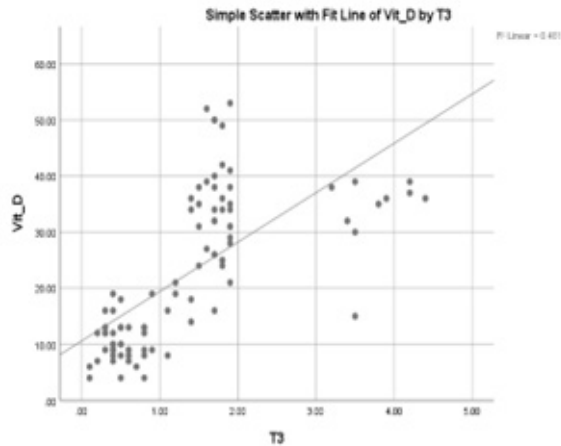


Figure 3. The correlation between T3 and Vit. D.

Table 3. Correlation between Vit. D and thyroid function tests.

Tests	R	P-value	Pearson's correlation coefficient (R2)
<b>T3</b>	0.67	Less than 0.001	0.46
<b>T4</b>	0.71	Less than 0.001	0.5
<b>TSH</b>	-0.71	Less than 0.001	0.51

## DISCUSSION

Thyroid-stimulating hormone is reflected as the most crucial indicator for the assessment of thyroid functions<sup>(10)</sup>. Free-T3 and FT4 are the dynamic biological states in plasma; therefore, FT3 and FT4 are delicate and meaningful indicators for identifying thyroid diseases<sup>(11)</sup>. Nevertheless, the report of free thyroxine is not consistent and steady; it may be affected by several factors such as thyroglobulin (TGB), serious illnesses, or definite drugs that interfere with the binding of hormones. Additionally, the determination of FT3 and FT4 is indirect, with no direct quantitative measurements. Consequently, the approval of TSH combined with FT4 is the basis for the assessment of thyroid function but is not enough; therefore, serums T3, T4 and TSH were evaluated among study participants to provide more convenience and meaningful parameters for thyroid function. The current study's findings showed that the vitamin-D-insufficiency group had a significantly higher TSH level than the other group. This implies a significantly greater prevalence of vitamin D insufficiency in hypothyroidism patients than in those with normal thyroid function. This is consistent with and underpinned by the results of

previous studies, which showed that patients suffering from hypovitaminosis D are significantly related to the grade and severity of hypothyroidism<sup>(12,13)</sup>.

Moreover, a study conducted in the Netherlands has shown that vitamin D deficiency is not associated with the initial stages of thyroid autoimmunity<sup>(14)</sup>, as Simsek and colleagues found out that vitamin D is strictly linked with antithyroglobulin antibody<sup>(15)</sup>. However, on the other hand, a study by Mckaway and colleagues confirms that vitamin D has no relation to antithyroglobulin, with non-significant differences in T4 and FT4 with vitamin D deficiency<sup>(12)</sup>. Furthermore, in this study, a significant relationship is found whereby a decrease in serum T3 correlates with vitamin D deficiency, thus contradicting the study of Niafar and colleagues. They hinted at increased TSH in patients with vitamin D deficiency<sup>(11)</sup>.

Vitamin D affects the level of TSH and may vary depending on age and sex, as it appeared in a study by Smith and colleagues that vitamin D administration significantly suppressed TSH secretion in the basal state. They also showed that serum TSH levels of middle-aged and older women were higher than those of men of the same age<sup>(16)</sup>. This result may indicate that

TSH secretion is regulated by sex hormones, genetic susceptibility, or environmental factors, which may also mediate the relationship between vitamin D status and serum TSH level<sup>(17)</sup>. In addition, another study found that circulating estrogen could induce serum TSH suppression in males by acting on the pituitary and vitamin D. It has been shown to have an essential role in estrogen synthesis of both female and male gonads<sup>(18)</sup>. In a recent study, a negative relationship has been found between TSH levels and deficiency in vitamin D, as approved by many other researchers: one of them reported that higher TSH levels were associated with vitamin D deficiency after sex and age adjustments and in euthyroid adults<sup>(19)</sup>.

Additionally, there is considerable evidence in favour of a strong association between thyroid function tests and the level of vitamin D. A recent meta-analysis of twenty case-control studies found that AITD cases are more likely to have a lower level of vitamin D than the control group<sup>(20)</sup>.

In conclusion: vitamin D deficiency is significantly associated with hypothyroidism; therefore, vitamin D supplementation is highly recommended to those deficient patients with insufficient levels to maintain vitamin D concentration in the blood, which avoids risks of thyroid and other related disorders.

#### **Acknowledgement**

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#### **Conflict of Interest**

No conflict of interest to declare.

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