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Hypothyroidism and 25-Hydroxyvitamin D Correlation Study

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Abstract

Background: Thyroid disease is one of the most common illnesses in the UAE, which could be linked to vast numbers of people suffering from vitamin D deficiency. This study aimed to explore the association between serum 25(OH)D levels and thyroid function parameters in men and women with diagnosed hypothyroidism.

Methods and Results: This cross-sectional observational study included 86 patients (78[90.7%] women and 8[9.3%] men) with diagnosed hypothyroidism. The patients were divided into two groups, male and female. These two groups were compared in terms of age, TSH, free-T4 (FT4), vitamin D, free-T3 (FT3), and body mass index (BMI). In addition, the correlation between levels of vitamin D and TSH was also examined in these two groups.

The mean age of the patients was 27.5 years, and BMI was 28.00 kg/m^2, indicating overweight. Vitamin D deficiency was found in 61(70.9%) patients and severe vitamin D deficiency in 10(11.6%) patients with hypothyroidism. 25(OH)D levels were significantly low in patients with high TSH levels, showing a weak negative correlation (r=-0.132, P=0.043). A negligible positive correlation was identified between 25(OH)D levels and FT4 r=0.089, P>0.05) and FT3 (r=0.071, P>0.05), and a negligible negative correlation with BMI (r=-0.059, P>0.05).

Conclusion: There is a clear indication that vitamin D deficiency is prevalent in hypothyroid patients and that these subjects have lower levels of serum 25(OH)D. Suggesting that lower serum 25(OH)D is related to hypothyroidism and the deficiency in vitamin D plays a role in the development of the disease. **(International Journal of Biomedicine. 2024;14(2):270-274.)**

Keywords: 25-hydroxyvitamin D • vitamin D deficiency • thyroid-stimulating hormone • hypothyroidism

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Abbreviations

25(OH)D, 25-hydroxyvitamin D; **TSH**, thyroid-stimulating hormone; **BMI**, body mass index; **VDR**, vitamin D receptor; **HT**, Hashimoto's thyroiditis.

Introduction

Hypothyroidism is a disease caused by inadequate synthesis and/or release of thyroid hormones. Thyroid dysfunction is a common condition that affects between 3% and 21% of the population.[1] A negative feedback mechanism exists between thyroid-stimulating hormone (TSH) and thyroid hormones. The level is the most sensitive marker of thyroid status in an individual.[2] Subclinical hypothyroidism is diagnosed when TSH levels are high and circulating free T4 is normal.[3,4] Vitamin D, a lipid-soluble prohormone, besides its well-recognized role in calcium metabolism, also affects immune regulation.[5] The emerging prevalence of hypovitaminosis D in populations with hypothyroidism might be attributed to a strong homology between the molecular structure of vitamin D receptor (VDR) and the thyroid hormone receptor.[6,7] Most immune cells, including T cells, B cells, and antigen-presenting cells, such as dendritic cells and macrophages, express VDR.[8,9] Some polymorphisms in the *VDR* gene were shown to predispose people to autoimmune thyroid disease, including Graves' disease and Hashimoto's thyroiditis.[10-14]

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Thyroid disease is one of the most common illnesses in the UAE, which could be linked to vast numbers of people suffering from vitamin D deficiency.(15) This deficiency is a consequence of many different traditional and cultural traits, alongside religious teachings, followed by the vast majority of the Emirati population. First, traditional factors include the men wearing white clothing, also known as the thobe, to protect themselves from the sun. As for women, religious teachings instruct them to cover up, exposing only their faces and hands, and some even cover up their faces, further reducing the chance of sun exposure.(16) However, perhaps the main cause of the deficiency is the lack of outdoor physical activities, further reducing their exposure to the sun's rays.(17,18)

Serum levels of 25(OH)D can reflect the whole body's nutritional status and are used to indicate whether vitamin D is adequate in the body.(19-22) A growing body of research supports the important role of adequate vitamin D in health. Vitamin D has also been found to be associated with a variety of inflammation, which is reduced by vitamin D supplements. Vitamin D deficiency is more common in obese people or obesity-related diseases, such as diabetes, so vitamin D supplements may also be a potential treatment.(23-25) Most experts agree that 25(OH)D of <20 ng/ml is considered to be vitamin D deficiency, whereas a 25(OH)D of 21-29 ng/ml is considered to be insufficient.(26) The goal should be >30ng/ml in children and adults.

Studies suggest that vitamin D deficiency participates in the pathogenesis of hypothyroidism. However, contradictory research exists about the relationship between hypothyroidism and vitamin D deficiency. This study aimed to explore the association between serum 25(OH)D levels and thyroid function parameters in men and women with diagnosed hypothyroidism.

Materials and Methods

This cross-sectional observational study was conducted in Ajman state of the UAE at the Thumbay Hospital from February 2021 to April 2021. It included a total of 86 patients (78[90.7%] women and 8[9.3%] men) with diagnosed hypothyroidism of random ages in the Endocrinology Outpatient Clinic of Thumbay Hospital. The patients were divided into two groups, male and female. These two groups were compared in terms of age, TSH, free-T4 (FT4), vitamin D, free-T3 (FT3), and body mass index (BMI) after taking their informed written consent. In addition, the correlation between levels of vitamin D and TSH was also examined in these two groups.

Serum 25-hydroxyvitamin D [25(OH)D] levels were determined using chemiluminescent immunoassay. The subjects were divided into clinically relevant groups according to their serum 25(OH)D levels: ≥30.0 ng/ml (sufficiency), 20-29.9 ng/ml (insufficiency), <20 ng/ml (vitamin D deficiency), and <10 ng/ml (severe vitamin D deficiency).

The measurements of TSH, FT3, and FT4 were conducted by electrochemical luminescence (ECLIA) on Cobas 8000 (Roche Diagnostics, Germany). The provided TSH reference ranges for TSH, FT3, and FT4 were 0.27–4.2 mIU/L, 3.1–6.8 pmol/L, and 12.0–22.0 pmol/L. respectively. The criteria for overt hypothyroidism were TSH >4.20 mIU/L, FT3 <3.1 pmol/L, and FT4 <12.0 pmol/L. The criteria for subclinical hypothyroidism were TSH >4.20 mIU/L, and FT3 and FT4 levels in the reference ranges.

Statistical analysis was performed using the statistical software package SPSS version 21.0 (SPSS Inc, Armonk, NY: IBM Corp). For the descriptive analysis, results are presented as mean ± standard deviation (SD). The Student's unpaired and paired t-tests were used to compare two groups for data with normal distribution. A simple linear regression with a calculation of Pearson's correlation coefficient was performed. A probability value of *P*<0.05 was considered statistically significant.

Results

The mean age of the patients was 27.5 years, and BMI was 28.00 kg/m^2, indicating overweight. Vitamin D deficiency was found in 61(70.9%) patients and severe vitamin D deficiency in 10(11.6%) patients with hypothyroidism. Table 1 shows the mean values of all studied parameters in female and male patients. There was no statistical difference between groups regarding TSH, FT3, FT4, BMI, and 25(OH)D levels (*P*>0.05 in all cases).

Table 1.
Clinical characteristics of the study participants.

Parameter	Male	Female	P-value
Sex	8	78	<0.0001
Age (years)	29	26	0.26
25(OH)D, ng/ml	33.257	27.222	0.862
TSH, mIU/L	6.32571	6.26482	0.934
FT4, pmol/L	15.33714	15.81668	0.709
FT3, pmol/L	3.7857	3.9897	0.509
BMI, kg/m^2	28.443	27.564	0.374

25(OH)D levels were significantly low in patients with high TSH levels, showing a weak negative correlation (r=-0.132, *P*=0.043) (Figure 1). A negative correlation was found between 25(OH)D levels and the disease duration (Figure 2). A negligible positive correlation was identified between 25(OH)D levels and FT4 r=0.089, *P*>0.05) and FT3 (r=0.071, *P*>0.05) (Figures 3 and 4), and a negligible negative correlation with BMI (r=-0.059, *P*>0.05) (Figure 5).

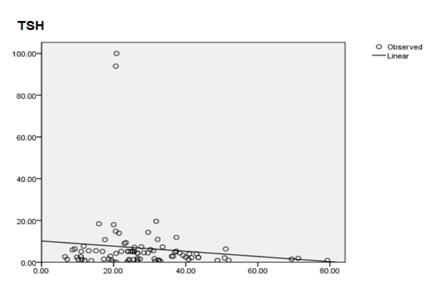

Fig. 1. *A negative correlation between 25-(OH)D and serum TSH (r=-0.132, P=0.043).*

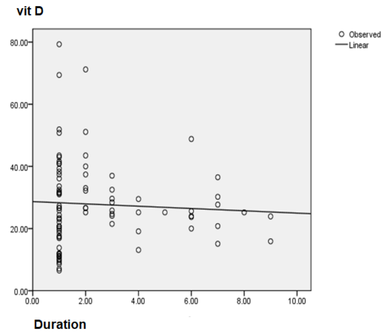

Fig. 2. *A negative correlation between 25-(OH)D and the duration of the disease.*

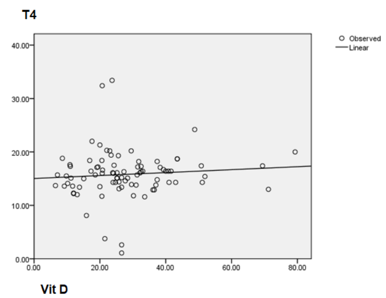

Fig. 3. *A positive* ***c****orrelation between 25(OH)D and serum T4 (r=0.089, P>0.05).*

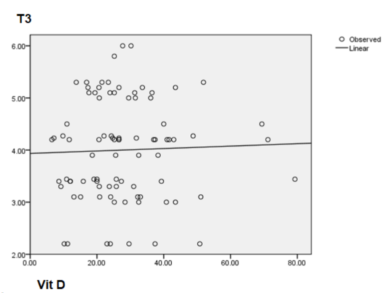

Fig. 4. *A* ***positive c****orrelation between 25(OH)D and serum T3 (r=0.071, P>0.05)*

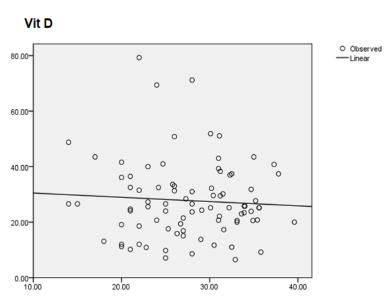

Fig. 5. *A negative correlation between 25(OH) and BMI (r=-0.059, P>0.05).*

Discussion

Hypothyroidism is one of the most common endocrine diseases in the UAE. It is more common in adults over 25. In our study, 90.7% of patients were women, while only 9.3% were male, with a male-to-female ratio of 10.1%.

25(OH)D is the principal stored form of vitamin D. The measurement of serum 25(OH)D levels is considered to be the best diagnostic test to assess the vitamin D status.[27] It reflects vitamin D produced cutaneously and obtained from food and supplements[28] and has a fairly long circulating half-life of 15 days. In contrast to 25(OH)D, circulating 1,25(OH)2D is generally not a good indicator of vitamin D status because it has a short half-life of 15 hours, and serum concentrations are closely regulated by a parathyroid hormone, calcium, and phosphate.[29] Levels of 1,25(OH)2D do not typically decrease until severe vitamin D deficiency.[30,31]

There are several studies suggesting that the prevalence of vitamin D deficiency is high in patients with thyroid diseases and that there is a relationship between hypothyroidism and vitamin D in these patients.[26] In our study, we found that 70.9% of patients with hypothyroidism had vitamin D deficiency, and 11.6% of patients had severe vitamin D deficiency (<10 ng/mL). We also found a negative correlation between vitamin D and TSH levels in these patients.

A study by Bozkurt et al.[32] demonstrated that serum 25(OH)D levels in the patients with Hashimoto's thyroiditis (HT) were significantly lower than those of controls, and 25(OH)D deficiency severity correlated with the duration of Hashimoto's thyroiditis. Supporting our study is another study by Ke et al.,[33] which found significant differences in serum 25(OH)D levels among mild HT, treated HT and controls. Compared with the control, treated and mild HT patients exhibited significantly lower 25(OH)D levels (45.77±3.48 vs. 83.49±6.24 nmol/L and 55.25±3.88 vs. 83.49±6.24 nmol/L, respectively, *P*<0.001 in both cases).

Hypothyroidism is associated with decreased thermogenesis and decreased metabolic rate and has also been shown to correlate with a higher BMI and a higher prevalence of obesity. There is clinical evidence suggesting that even mild thyroid dysfunction in the form of subclinical hypothyroidism is linked to significant changes in body weight and represents a risk factor for overweight and obesity.

Clinical evidence linking 25(OH)D level to thyroid function is limited and conflicting. A study performed among euthyroid adults showed a strong positive association of vitamin D deficiency with TSH levels after adjusting for age, gender, and season.[34] Another study also demonstrated a negative relationship between 25(OH)D levels and TSH in patients with hypothyroidism.[35] Our study is also consistent with a study by Mackawy et al.,[35] who recorded significant negative correlations between serum 25(OH)D and TSH and a positive correlation between serum 25(OH)D with T4. The studies by Sedrani,[36] Al-Jurayyan et al.,[37] Fida,[38] and Naeem et al.[39] stated that vitamin D serum levels were significantly lower in females than males. These studies showed that the prevalence of vitamin D insufficiency in HT cases (92%) was significantly higher than that observed in healthy controls (63%) (*P*<0.001). In a study by Mirhosseini et al.,[40] the number of patients with clinical and subclinical hypothyroidism significantly decreased after 12 months of vitamin D supplementation.

Conclusion

Our results indicated that patients with hypothyroidism suffered from hypovitaminosis D and were overweight. Moreover, there is a weak negative but significant correlation between serum 25(OH)D and TSH levels, suggesting that vitamin D deficiency is associated with the severity of hypothyroidism. Screening for vitamin D deficiency is highly recommended for all hypothyroid patients.

Ethical Considerations

The study protocol was reviewed and approved by the Ethics Committee at the Gulf Medical University, Ajman, UAE. Written informed consent was obtained from all the participants.

Competing Interests

The authors declare that they have no competing interests.

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