

## Vitamin D Deficiency as a Risk Factor in Autoimmune Thyroid Diseases: An updated Systematic Review

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### ABSTRACT

**Background and Objective:** Autoimmune thyroid diseases (AITDs), including Hashimoto's thyroiditis (HT) and Graves' disease (GD), represent some of the most prevalent endocrine disorders worldwide. Increasing evidence suggests that vitamin D, beyond its role in calcium homeostasis, acts as an immunomodulatory hormone. Vitamin D deficiency has been implicated as a contributing factor in the pathogenesis of autoimmune disorders, including AITDs. This review systematically evaluates the current evidence on the association between vitamin D deficiency and AITDs, with emphasis on differences in serum vitamin D levels between affected individuals and healthy controls, as well as the odds of vitamin D deficiency by disease status.

**Methods:** This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A comprehensive literature search was performed in PubMed, Scopus, Web of Science, and Google Scholar for studies published between January 2012 and December 2023. Eligible studies included randomized controlled trials, cohort studies, and case-control studies that reported serum vitamin D levels in patients with AITDs compared with healthy controls, or evaluated the odds of vitamin D deficiency by AITD status. Studies were screened for methodological rigor, inclusion criteria, and outcome measures.

**Results:** The evidence demonstrated heterogeneity across study designs and populations. Several studies reported significantly lower serum vitamin D levels in patients with HT or GD compared with healthy controls, suggesting a potential link between vitamin D deficiency and AITD risk. However, other studies failed to confirm this association. Differences in geographic location, sample size, baseline vitamin D status, and duration of follow-up contributed to these inconsistent findings.

**Conclusion:** Vitamin D deficiency may play a contributory role in the development and progression of autoimmune thyroid diseases. While current evidence supports a potential association, inconsistencies highlight the need for large-scale, multicenter randomized controlled trials to establish causality and to determine whether vitamin D supplementation could serve as a preventive or therapeutic strategy in AITDs.

**KEYWORDS:** vitamin D, vitamin D metabolism, autoimmune thyroid disease, Hashimoto's autoimmune thyroiditis, Graves' disease

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### INTRODUCTION

Thyroid disorders, irrespective of gender or age, rank among the most prevalent globally. In clinical practice, thyroid diseases, particularly autoimmune thyroid disorders, are frequently among the most prevalent endocrine conditions and represent the most common pathological affliction of the thyroid gland [1]. Various factors, including genetic, environmental, and hormonal influences such as vitamin D insufficiency, have been proposed to contribute to the etiology of autoimmune thyroid diseases (AITDs) [2]. A study by Agmon-Levin et al. revealed that individuals with systemic and organ-specific autoimmune illnesses exhibited decreased vitamin D levels compared to healthy persons, and that vitamin D supplementation enhanced autoimmune conditions [3].

AITD presents numerous heterogeneous clinical manifestations, primarily characterized by Graves' disease (GD) in cases of

hyperthyroidism with thyroid-stimulating hormone receptor antibodies (TRAb), and Hashimoto's thyroiditis (HD) in instances of hypothyroidism with positive thyroperoxidase antibodies (anti-TPO) or positive antibodies to thyroglobulin (anti-Tg). A cross-sectional observational study across various countries indicated that individuals who tested positive for these antibodies exhibited a higher prevalence of vitamin D deficiency and insufficiency compared to those who tested negative. Lymphocyte infiltrates in the gland are a defining pathogenic feature of autoimmune thyroid disease, irrespective of its manifestation. Histologically, a characteristic feature of autoimmune thyroid disease (AITD) is lymphocytic infiltration, predominantly including T cells that can progressively substitute thyroid follicles.

Hashimoto's thyroiditis, or chronic autoimmune thyroiditis, is the most prevalent organ-specific autoimmune disorder, exhibiting a markedly heightened frequency in recent decades. Hashimoto's thyroiditis is presently the predominant etiology of primary hypothyroidism in both adolescents and adults. The primary characteristic of the disorder is the existence of autoantibodies against thyroid peroxidase (TPOAb) or thyroglobulin (TgAb). Antibody titers exhibit a positive connection with hypothyroidism. This disorder is an autoimmune disease mediated by T-cells, characterized by the infiltration of lymphocytes in the thyroid. The precise etiology remains unclear, however the pathophysiology of Hashimoto's disease is thought to involve genetic factors, environmental stimuli, and epigenetic impacts.

The primary function of active vitamin D (calcitriol or 1,25-dihydroxyvitamin D3) is to regulate calcium and phosphate levels; however, emerging data indicates that vitamin D is also linked to non-skeletal functions. The majority of cells and organs in the body, including muscles, heart, blood vessels, pancreas, brain, mammary glands, colon, prostate, gonads, skin, immune cells, and malignant cells, possess nuclear vitamin D receptors (VDR) and enzymes that facilitate calcitriol synthesis, which are not influenced by parathyroid hormone in these locations. Vitamin D exerts its biological effects primarily via binding to the vitamin D receptor (VDR), thereby influencing the expression and transcription of many coding genes that regulate cell proliferation, differentiation, and apoptosis through the genomic pathway. Consequently, vitamin D exhibits pleiotropic effects and may function in a paracrine or autocrine capacity alongside its endocrine role. This information elucidates the supplementary non-calcitropic effects of vitamin D, including its role in autoimmune, endocrine, viral, metabolic, and neurological diseases, along with mood problems. The presence of VDR in immune cells indicates that vitamin D is crucial for the regulation of both innate and adaptive immune systems. Vitamin D insufficiency can compromise immune system integrity and result in insufficient immunological responses, including autoimmune disorders [6]. Impaired immunological tolerance mediated by T and B lymphocytes led to aberrant autoantibody infiltration of the thyroid glands, which constituted the primary cause of Hashimoto's thyroiditis. Moreover, vitamin D modulates the immune system and is a recently recognized immunomodulatory hormone. Common thyroid disorders, or тиреоидит, encompass Hashimoto's thyroiditis and Graves' disease (HD); autoimmune mechanisms frequently contribute to their pathogenesis [7, 21].

This research aims to conduct a comprehensive descriptive analysis of vitamin D levels and their association with autoimmune thyroid diseases (AITDs), while investigating the impact of vitamin D supplementation on these conditions. The review consolidates research evidence indicating that patients with AITD exhibit decreased serum levels of vitamin D compared to individuals without similar disorders. The paper assesses current studies to illustrate the significant impact of vitamin D deficiency on the development of autoimmune thyroid disorders. The study indicates that vitamin D levels have to be regarded as both a modifiable risk factor and a potential therapeutic avenue for addressing thyroid autoimmunity.

## MATERIALS AND METHODS

### 2.1 Literature Search Strategy

A systematic literature search was performed using the major electronic databases PubMed, Medline, Google Scholar, the Cochrane Library, and ScienceDirect. The search focused on studies investigating the role of vitamin D in immune system modulation, with particular emphasis on autoimmune thyroid disorders. The search covered publications from January 2012 to December 2024. Search terms included combinations of the following keywords: "Hashimoto's disease," "chronic autoimmune thyroiditis," "Graves' disease," "vitamin D," "vitamin D deficiency," "vitamin D insufficiency," "vitamin D in Hashimoto's disease," "thyroperoxidase antibodies (TPOAb)," and "thyroglobulin antibodies (TgAb)." Boolean operators ("AND," "OR") were used to refine the search and ensure comprehensive coverage of relevant literature.

### 2.2 Study Selection

All retrieved records were screened for duplicates, which were subsequently removed. Titles and abstracts were reviewed to identify studies meeting the general inclusion criteria. Irrelevant or unrelated studies were excluded at this stage. The full texts of potentially eligible articles were then reviewed in detail to confirm their relevance to the research question and their methodological adequacy. Studies failing to meet the eligibility requirements were excluded.

### 2.3 Inclusion and Exclusion Criteria

Studies were included if they (i) investigated the relationship between vitamin D status and autoimmune thyroid diseases, particularly Hashimoto's thyroiditis (HT) or Graves' disease (GD); (ii) provided data on vitamin D levels, supplementation, or deficiency; and (iii) examined associations with thyroid autoantibodies or immune parameters. Both observational and interventional studies were considered. Exclusion criteria comprised studies that did not directly address vitamin D and autoimmune thyroid disorders, lacked sufficient methodological clarity, or failed to provide relevant quantitative or qualitative data. Duplicates and studies presenting unverifiable or low-quality results were also excluded. Only articles published in English or Russian were included to ensure linguistic consistency and interpretability.

**2.4 Data Extraction and Synthesis**

Data extraction was conducted manually through detailed examination of the full-text articles. Information collected included study design, population characteristics, diagnostic criteria, intervention or exposure details, and primary findings. Extracted data were summarized and organized to allow for cross-study comparison. The synthesis of evidence was performed narratively due to the heterogeneity in study design, population size, vitamin D assessment methods, and outcome measures. Results were analyzed to identify convergent findings, inconsistencies, and potential mechanistic insights into the immunomodulatory effects of vitamin D in autoimmune thyroid diseases. Given the variability of study methodologies and outcomes, a quantitative meta-analysis was not undertaken.

**RESULTS**

The database search produced 562 articles which were reduced to 517 unique records after removing duplicate entries. The screening process of titles and abstracts resulted in the exclusion of 214 studies because they did not meet the research criteria. The full-text evaluation of 102 articles resulted in 19 studies being selected for final analysis after applying all inclusion and exclusion criteria. The research evidence shows that people need sufficient vitamin D intake to achieve proper immune system operation and maintain their body health. The research studies demonstrated that vitamin D supplements showed promise for treating or enhancing autoimmune thyroid diseases including autoimmune thyroiditis (AIT) and Hashimoto’s disease (HD). The research studies showed that autoimmune thyroid disease patients had lower vitamin D blood levels and more cases of deficiency than participants in the control groups. The research shows that people with low vitamin D levels face higher risks of developing thyroid autoimmunity which makes vitamin D maintenance crucial for immune system stability and thyroid gland health.

**3.1 Vitamin D and autoimmune thyroid diseases**

Research evidence demonstrates that autoimmune thyroid diseases occur frequently in people with low vitamin D blood levels which has driven scientists to investigate cholecalciferol supplementation for disease management. The lack of direct pharmacological treatments for thyroid autoantibody reduction has not stopped researchers from conducting multiple clinical trials to study vitamin D supplementation effects on hyperthyroidism (Table 1). The majority of adult participants who received cholecalciferol supplements during hyperthyroidism treatment with vitamin D deficiency showed decreased thyroid autoantibody levels (TPOAb and TgAb) and elevated serum calcidiol levels above 30 ng/mL. The research indicates that vitamin D supplementation produces positive effects on autoimmune hypothyroidism through its ability to modify immune system function. The antibody levels decreased in all participants regardless of their initial vitamin D status [1].

Research studies have established that people with low vitamin D levels face an elevated risk of developing autoimmune thyroid diseases (AITDs). The development of AITDs including Hashimoto’s thyroiditis and elevated antithyroid antibodies becomes more likely when serum vitamin D levels reach 10 ng/mL (25 nmol/L) [2]. Research shows that patients with high thyroid antibody levels have lower 25(OH)D<sub>3</sub> concentrations than patients without thyroid antibodies. The study by Unal et al. revealed that thyroid autoantibodies showed a direct relationship with decreased vitamin D levels [3]. The study by Kivity et al. showed that patients with thyroid diseases had lower vitamin D levels than participants without thyroid diseases [4]. The research by Sayki Arslan et al. revealed that people with vitamin D deficiency developed thyroid autoantibodies at higher rates. The study by Bozkurt et al. showed that patients with vitamin D levels below 10 ng/mL had lower anti-TPO and anti-TG antibody levels [6]. The study by Muscogiuri et al. showed that vitamin D levels in patients with chronic autoimmune thyroiditis had a negative correlation with anti-TPO antibody levels [7]. The Chinese population study revealed that anti-TG positive patients had higher rates of vitamin D deficiency which might explain why insufficient vitamin D levels weaken thyroid autoimmunity protection [8]. Research shows that patients with vitamin D deficiency have elevated thyroid autoantibody levels than patients with sufficient vitamin D because vitamin D helps control inflammatory cytokines and supports immune system tolerance [9, 10].

**Table1. Studies of vitamin D and antithyroid antibody levels**

Authors	Number of registered patients	A country	Determination of vitamin D deficiency	Main conclusions
Unal, Asli Dogruk, et al. [3]	405	Turkey	< 20 ng/ ml	Level 25 (OH)D was negatively correlated with anti-TG (P=0.025) and anti-TPO (P = 0.003) levels.
Kivity, Shaye et al. [4].	190	Hungary	Mg<10 ng/ml	25(OH) D deficiency was higher in patients with AITDs compared to the control group (P <0.001); vitamin D deficiency correlated with antithyroid antibody titer (P=0.01).
Sayki Arslan, Muyesser, et al. [5]	155	Türkiye	Patients < 20 ng/ ml	showed a negative correlation between anti-TPO, anti-TG and 25(OH)D3 levels (P = 0.017; P= 0.05)
Bozkurt, Nujen Colak, et al. [6]	540	Turkeyi	<20 ng/ml	Vitamin D level negatively correlates with the level of anti-TPO (P< 0.001) and anti-TG (P< 0.001). The severity of vitamin D deficiency (<10 ng/ml) correlates with the level of thyroid antibodies.

Muscogiuri, Giovanna, et al. [7]	168	Italy	<20 ng/ml	Showed a correlation between the level of 25(OH) D and anti-TPO (P = 0.03). No correlation was found between vitamin D and anti-TG levels (p = 0.25).
Wang, Xinling, et al. [8]	1714	China	<20 ng/ml	A negative correlation (P = 0.014) was found between vitamin D and anti-TG titers only in women.
Kim, Choon-Young, et al. [10]	4356	South Korea	<10 ng/ml	Vitamin D deficiency was associated with increased anti-TPO (+) levels in premenopausal women <i>π</i> μενοπαυσε(P<0.001)
Choi, Yun Mi, et al. [9]	6685	South Korea	<10 ng/ml	Decreased 25 (OH) D3 levels were significantly associated with autoimmune thyroid diseases, especially in premenopausal women <i>π</i> μενοπαυσε(in the TPO - Ab(+) group - P= 0.003). In the groups of anti-TPO (+)/ultrasound (+) - P < 0.001).

**3.2 Efficacy of Vitamin D Supplementation in Autoimmune Thyroiditis**

The effectiveness of vitamin D treatment has been evaluated in patients with autoimmune thyroiditis (Table 3). Krysiak, R., K. Kowalcze, and B. Okopien report that vitamin D administration lowers thyroid antibody levels (anti-TPO more than anti-TG). Vitamin D supplementation had a greater effect on anti-TPO and 25(OH) levels in patients with vitamin D insufficiency than in those with normal vitamin D levels [11]. Mazokopakis, Elias E., et al. proposed that vitamin D insufficiency may be associated with the etiology of hypertension, and that the addition of cholecalciferol (CF) may lower TPO antibodies and contribute to the therapy of chronic autoimmune thyroiditis [12]. Simsek, Yasin, and the others. Vitamin D therapy has also been shown to lower TPO and TG antibody levels in vitamin D deficient patients [13]. Chauhary, Sandeep C., and colleagues discovered that high-dose vitamin D treatment (about 60,000 IU/week) in hypertensive individuals was related with a considerable drop in anti-TPO levels [14]. Chahardoli, Reza, and co-authors also recommended a high dose of vitamin D3 [15], citing that using low-dose supplements (vitamin D3 1000 IU/day or 400 IU/day) for 16 weeks had no significant effect on thyroid gland autoimmune processes [16]. Most studies demonstrate that vitamin D can reduce thyroid antibody levels, however the effect may vary depending on the amount. Evidence suggests that vitamin D supplementation at levels < 1000 IU for < 2 months does not generate the desired effect [17]. In contrast to the previous investigations, Anaraki, Parichehr Vahabi, et al. It has been observed that taking 50,000 IU of cholecalciferol weekly for 12 weeks in patients with hypertension and vitamin D insufficiency may not have a significant effect on thyroid gland function or autoimmune processes [18]. According to the Endocrinological Society, a 25(OH)A D level of less than 20 ng/ml shows a deficit, while 20-29 ng/ml and 30 ng/ml suggest insufficient and sufficient vitamin D levels, respectively [18-21]. (Table 2).

**Table 2. Several studies with a significant decrease in antithyroid antibody titers after taking vitamin D (cholecalciferol).**

Authors	Number-of registered patients	Country	Criteria for vitamin D deficiency	Dose and duration of supplementation	Main results
Chahardoli, Reza, et al.2019[14]	42 women	Iran	< 20 ng/ml	50,000 IU of vitamin D, once a week (for 3 months)	Vitamin D supplementation reduced anti-TG levels (P= 0.009).
Krysiak, R., K. Kowalcze, and B. Okopien 2022[11]	53 women	Poland	< 20 ng/ml	4000 IU / day (in the vitamin D deficientgroup), 2000 IU / day ( in the vitamin D deficientgroup)-for 3 months	, Vitamin D reduced anti-TPO levels. This association was more often found in women with vitamin D deficiency (P = 0.065).
Mazokopakis, Elias E., et al. 2015 [12]	218	Greece	< 30 ng/ml	Cholecalciferol, 1200-4000 IU, daily, for 4 months (to maintain 25(OH) levelsD ≥ 40 ng/ml)	Administration of cholecalciferol in patients with hypertension with vitamin D deficiency reduces the level of antibodies to TPO.
Simsek, Yasin, et al.2,016[13]	82	Turkey	<20 ng/ml	Vitamin D 1000 IU per day (for 1 month)	Vitamin D supplementation reduced TPOAbTPOAb and TG-Ab levels (P = 0.02 and P = 0.03)
Chauhary, Sandeep, et al.2,016[14]	102	Indium	<50 nmol/L	CF 60,000 IU per week and for 8 weeks;	A significant decrease in anti-TPO levels was found (P = 0.028)
Knutsen, Kristen V., et al. 2017 [15]	J	Norway2 51	AverageD3 contentD- 26nmol/l	Take Vitamin D3 intake Dat a dose of 1000 IU or	does not affect the level of anti-TPO.

			400 IU per day for 16 weeks	
Anaraki, Parichehr Vahabi, et al. 2017[17]	56	Iran	<20 ng/ml	Vitamin D 50,000 IU weekly (for 12 weeks) A decrease in TPOAb was found (P = 0.14)
Behera et al. 2020 [18]	23	India	<20 ng/ml	Vitamin D 60,000 IU weekly 6 months Vitamin D reduced anti-TPO levels
Jiang et al. 2023[19]	179	China	<20 ng/ml	Vitamin D 800 IU daily 6 months Vitamin D reduced anti-TPO levels and AT-TG
Mei et al. 2021 [20]	36	China	< 30 ng/ml	Vitamin D 800-1200 IU daily for 6 months Vitamin D supplementation reduced TPOAb/TPOAb and TG-Ab levels (P = 0.02 and P = 0.03)
Robat-Jazi et al. 2022[21]	40	Iran	< 30 ng/ml	Vitamin D 50,000 IU weekly, 3 months Vitamin D reduced the level of AT-TPO and AT-TG

**3.3 Impact of Vitamin D Supplementation on Autoimmune Thyroiditis: Antibody Reduction and Immune Modulation**

Several studies conducted over the last decade have found significant reductions in TPOAb and/or TgAb levels in adult individuals with autoimmune thyroiditis. 9 out of 14 occurrences occurred following vitamin D treatment in various populations (Table 3): Iran, Turkey, Greece, India, Poland, and Iran [6,12-15]. Vitamin D intake can range from 50,000 to 60,000 IU per week for 2-3 months [14, 15, 22, 23], or 1,000 to 4,000 IU/day for 1-6 months. Researchers also found that the duration of vitamin D intake affects the decrease in antibody titer[19,24,25,26,24]. Furthermore, several researchers have recently suggested that vitamin D administration may influence other immune markers. Supplementing adult patients with AIT with 50.00 IU of vitamin D weekly for 3 months improved their immune system by lowering the Th17/Treg ratio, inflammatory markers such IFN-γ and TNF-α, and IL-10 (a pro-inflammatory cytokine). The vast range of vitamin D supplementation doses and durations makes it difficult to develop and thus prescribe an appropriate vitamin D regimen in patients with AIT[27].

**Table 3. CReduction of antithyroidantitireoidных antibody titers after vitamin D (cholecalciferol)administration, depending on the duration of administration.**

Author, year and country	Number of participants	Dose additives	Duration
Muscogiuri et al., 2016 (Italy) [6]	168	2000 IU/day	6 monthEV
Simsek et al., 2016 (Turkey) [12]	37	1000 IU/day	for 1 month
Mazokopakis et al., 2015 (Greece) [13]	173	1200-4000 IU/day,	4 months
Chaudhary et al., 2016 (India) [14]	39	of 60 000 IU weekly	for 8 weeks
Chahardoli et al., 2019 (Iran) [15]	42	50 000 IU weekly	for 3 months
Robat-Jazi et al., 2022 (Iran)[22]	40	50 000 IU weekly	for 3 months
Mirhosseini et al., 2017 (Canada) [24]	103	>40 ng/ml	12 months
Štefanić et al., (Croatia) 2020 [26]	2263	2000 IU/day	6 monthEV
Bhakat et al., 2023 (India) [23]	50	60 000 IU weekly	for 8 weeks
Krysiak et al., 2022 (Poland) [27]	42	4000 IU daily	for 6 months
Cvek et al., (Croatia )2021 [25]	461	1000 IU/day	for 6 months

**3.4 Vitamin D Deficiency and Graves’ Disease: Associations with TRAb, Thyroid Volume, and Treatment Outcomes**

Several recent studies have found a link between low VitD and GD levels (Table 4). Furthermore, Zhang et al. [28] were the first to demonstrate the link between vitamin D levels and TRAb titers. According to Yasuda et al. [29], the GD group (65.4%) had significantly higher levels of vitamin D insufficiency (p < 0.05) than the control group (32.4%). There was a significant association between vitamin D levels, calcium levels (r = 0.49; p < 0.05), and unchanged parathyroid hormone concentrations (r

= -0.50; p < 0.05). There was a strong association between thyroid volume and 25 (OH)-vitamin D levels (r = -0.45; p < 0.05), but no correlation was seen between TRAb values and thyroid function [30].

Interestingly, Ma et al. We have shown that relapses of HD are common in such conditions. Vitamin D levels may play an essential role in treatment response, since lower levels are associated with a decreased chance of remission and a higher rate of relapse when using antithyroid medications[31].

**Table 4. Relationship between Graves ' disease and vitamin D levels**

Study	Patient GroupB (W / M)	Control groupA (W / M)	Age of the examined group	Age of the control group	Serum vitamin D level (ng/ml)	vitamin D level in the control group	TRAb level IU / l	Association
Yasuda 2012 et al.[29]	26/0	46/0	37.3 ± 13.0	44.3 ± 18.1	14,4 ± 4,9 (ng/ml)	17.1 ± 4.1 (ng/ml)	19.9 ± 18.1	+
Jyotsna, 2012 et al.[10]	62/18	62/18	36.33 ± 11.15	36.42 ± 10.40	12,67 ± 6,24 (ng/ml)	10.99 ± 7.05 (ng/ml)	--	-
Unal et al . [3] 2014	27(W/M)	124	44.6	44.6	14.9 (4-39) (ng/ml)	19.9 (9-122.7) (ng/ml)	-	+
Ma et al., 2015 [31]	70 (W / M)	70	40.04 ± 15.24	41.99 ± 13.31	31,71 ± 13,10 (nmol/l)	41.33 ± 14.48 (nmol/L)	14.16 (5.81-27.92)	+
Kim et al., 2016 [32]	148 (W / M)	407-48	-	.6 ± 13.3	39,3 ± 22,0 (ng/ml)	39.9 ± 21.5 (ng/ml)	--	-
Ke et al., 2017 [33]	30/21	31/20	39.79 ± 1.73	36.48 ± 1.68	81,77 ± 5.60 (nmol/L)	83.49 ± 6.24 (nmol/L)	--	-
Planck et al., 2018 [34]	246/46	921/1384	45.5 ± 13.1	59.4 ± 7.2	55,0 ± 23,2 (nmol/ l)	87.2 ± 27.6 (nmol/ L)	-	+
Mangaraj, 2019 et al.[35]	54/30	25/17	35.25 ± 9.70	32.41 ± 9.71	19,22 ± 8,95 (ng/ml)	23.81 ± 12.46 (ng/ml)	19.45 ± 12.12	+

## DISCUSSION

Research studies have proven that autoimmune thyroid disease patients (AITDs) have lower 25(OH)D serum levels and develop vitamin D deficiency at higher rates than people without these diseases [12, 17, 19]. Research shows that vitamin D supplements help patients achieve better thyroid function improvement and autoantibody reduction including TPOAb and TgAb [38, 39]. Multiple studies have proven that vitamin D supplementation results in substantial decreases of TPOAb and TgAb antibody levels which supports previous research findings from Zhang et al. [36] and Wang et al. [37] and Liu et al. [38]. The results from multiple-site clinical research showed that vitamin D treatment reduced TPOAb and TgAb levels in all patients regardless of their thyroid status and simultaneously raised their free triiodothyronine (fT3) blood levels. The study by Krysiak et al. [12] showed that vitamin D treatment led to substantial decreases in TPOAb and TgAb levels among patients with hyperthyroidism and subclinical hypothyroidism who received L-T4 therapy for at least six months but no changes occurred in patients with normal thyroid function.

Research shows that vitamin D deficiency exists at high rates in people with autoimmune thyroid diseases which might help trigger or advance their condition. The results from various multicenter randomized clinical trials demonstrate that vitamin D supplements should be used as an additional treatment for AIT patients receiving standard medical care. Research indicates that vitamin D treatment makes thyroid medications more effective for managing both hypothyroidism and hyperthyroidism [39]. The research evidence demonstrates that proper vitamin D levels help control thyroid autoimmunity while leading to better treatment results for patients with these conditions.

## CONCLUSIONS

Research findings show that vitamin D deficiency in serum together with specific gene variations leads to the development of chronic autoimmune thyroiditis (CAIT) and diffuse toxic goiter (DTZ). The research shows that patients with autoimmune thyroid disorders have lower than normal vitamin D levels and these deficiencies create conditions for thyroid autoantibody development and thyroid function deterioration. The scientific evidence supports that vitamin D deficiency plays a crucial role in developing autoimmune diseases. Multiple research studies including large-scale clinical trials support vitamin D supplementation as a treatment for autoimmune thyroid diseases. The combination of vitamin D with standard medications used for hypothyroidism and hyperthyroidism treatment produces better therapeutic results. Multiple research studies including interventional and randomized controlled trials investigate how vitamin D levels affect autoimmune thyroid diseases and evaluate its therapeutic value for disease management. Research in this field will help scientists create new treatment methods and prevention strategies for autoimmune diseases which will enhance patient life quality. No research studies have been conducted in Kyrgyzstan to evaluate vitamin D levels between people with chronic diseases and those who are healthy. The scientific community lacks published research about this specific topic throughout the entire republic. The research on vitamin D status and its clinical value for Kyrgyzstan becomes essential because thyroid gland disorders make up 52% of all endocrine diseases in the country.

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