

Comparative Assessment of Serum Vitamin D and Calcium Levels in Hypothyroid Patients in Albayda, Libya

Nusieba A. Mohammed Ibrahim  and Yahya Saber E. Mansour 

Department of Pharmacology and Toxicology, Faculty of Pharmacy, Omar Al-Mukhtar University, Albayda, Libya

Correspondence:

Nusieba Ibrahim, MSc,
Department of Pharmacology
and Toxicology, Faculty of
Pharmacy, Omar Al-Mukhtar
University, Albayda, Libya.
E-mail: nusieba.ibrahim@omu.
edu.ly

Received: September 23, 2025;

Revised: October 26, 2025;

Accepted: November 14, 2025

© The Author(s) 2026. Open Access



This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made.

ABSTRACT

OBJECTIVE Vitamin D is essential for the proper functioning of numerous organs, including the thyroid gland. For that reason, a deficiency in vitamin D is considered a potential risk factor for developing various thyroid disorders, particularly hypothyroidism. The present study aimed to evaluate the serum concentrations of vitamin D and calcium in individuals who have been diagnosed with primary hypothyroidism.

METHODS The research was conducted on a cohort of 100 hypothyroid patients at the Department of Internal Medicine, Albayda Medical Center, in Albayda, Libya. Serum levels of vitamin D, calcium, and thyroid profiles (thyroid stimulating hormone (TSH), T3, and T4) were measured in all participants. A control group consisting of 100 healthy individuals was used for comparison. Statistical analysis was performed using SPSS software version 20.0 with independent t-tests and Pearson correlation analysis.

RESULTS Our findings indicate that the serum levels of vitamin D and calcium were significantly lower among the hypothyroid group compared to the control group (12.21 ± 2.02 ng/mL and 4.40 ± 1.24 mg/dL vs 45.53 ± 10.51 ng/mL and 10.88 ± 1.45 mg/dL, $p = 0.008$ and 0.006 , respectively). However, we noticed non-significant differences in changes in the serum levels of vitamin D and calcium between males and females in the hypothyroid group ($p = 0.578$ and 0.410 , respectively). Pearson correlation analysis indicated that the TSH levels of the hypothyroid group had statistically significant negative correlations with the serum vitamin D and calcium levels ($r = -0.144$, $p = 0.030$ and $r = -0.145$, $p = 0.029$, respectively).

CONCLUSIONS Based on these results, it is strongly advised that individuals with hypothyroidism be screened for vitamin D and calcium deficiencies and, if necessary, receive appropriate supplementation.

KEYWORDS vitamin D, calcium, hypothyroidism, vitamin d deficiency, Albayda

INTRODUCTION

Vitamin D is a fat-soluble vitamin that is crucial for regulating several minerals, especially calcium. It is synthesized in the skin upon exposure to sunlight, especially ultraviolet B rays (1). Vitamin D is also present in a variety of dietary sources,

including liver, fortified dairy products, fatty fish, and nutritional supplements (2). There are two main types of vitamin D: D2 (ergocalciferol), which is present in certain plants and fortified food products, and D3 (cholecalciferol), which is synthesized in the skin and is found in animal-

derived foods (2). Once in the body, vitamin D is converted in the liver to 25-hydroxyvitamin D, its primary circulating form. It is then further converted into its active form, 1,25-dihydroxyvitamin D (calcitriol), in the kidneys (3). The thyroid gland, a butterfly-shaped gland located anteriorly in the lower part of the neck, is essential for regulating the body's metabolism through the production of thyroid hormones, mainly triiodothyronine (T₃) and thyroxine (T₄) (4). Additionally, the parafollicular cells (C cells) of the thyroid gland produce and secrete calcitonin, a hormone involved in maintaining calcium homeostasis in the bloodstream (5). Vitamin D plays an important role in maintaining bone health and proper bone mineralization. Recent studies have indicated a correlation between low vitamin D levels and various health issues, including cardiovascular disease, diabetes, cancer, obesity, and osteoporosis (6). A growing body of evidence also supports a significant association between vitamin D deficiency and hypothyroidism. For example, previous studies have shown that the prevalence of vitamin D insufficiency in individuals with Hashimoto's thyroiditis is markedly higher (92.0%) compared to healthy controls (63.0%) (7, 8). Additionally, studies have reported that patients with Graves' disease also often present with low levels of Vitamin D (9, 10). Furthermore, studies have identified a negative correlation between serum vitamin D levels and both calcium and thyroid-stimulating hormone (TSH) levels (11). Consequently, our current study was undertaken to evaluate serum vitamin D and calcium levels in Libyan individuals with hypothyroidism due to high prevalence of both vitamin D deficiency and hypothyroidism in Libya, which are linked to negative health outcomes.

METHODS

This study was conducted at the Department of Internal Medicine at Albayda Medical Center, Albayda, Libya, from January to December 2024, involving 100 patients diagnosed with hypothyroidism and 100 healthy individuals. The hypothyroid group was recruited from the Department of Internal Medicine of Albayda Medical Center, while the control group was recruited from Albayda Medical Center staff members. The inclusion criteria for the hypothyroid group were patients diagnosed with primary hypothyroidism

who were taking anti-hypothyroidism medications (e.g., levothyroxine) for almost 5 years. We excluded from the study any individual with hepatic or renal disorders, malignancy, pregnancy, lactation, or having medications altering bone metabolism. The controls included individuals with no history of hypothyroidism and who were not taking vitamin D supplements during the study period. Blood samples were collected from all participants after an 8-hour fasting period. The levels of T₃, T₄, and TSH were measured using the Cobas c111 ECLIA analyzer (Roche Diagnostics GmbH, Mannheim, Germany). The normal reference ranges for serum thyroid profiles are 1.4-4.4 pg/dL for T₃, 0.7-2.1 ng/dL for T₄, and 0.3-4.0 mU/L for TSH (12). The serum levels of vitamin D and calcium were measured using a Cobas e411 ECLIA analyzer (Roche Diagnostics GmbH, Mannheim, Germany). Data are presented as mean $\pm$ standard deviation (mean $\pm$ SD) and were analyzed using SPSS software, version 20.0. Serum vitamin D and calcium levels of the control and hypothyroid groups were compared using independent t-tests, while Pearson correlation analysis was applied to assess the association between vitamin D/calcium levels and TSH levels in the hypothyroid group. We also used independent t-tests to compare serum vitamin D and calcium levels of males and females of the hypothyroid group because females made up the vast majority of that group (70.0%) in our study. Results were considered significant when $p < 0.05$.

RESULTS

Our study included 100 hypothyroid patients (30 males and 70 females) and 100 healthy controls (45 males and 55 females). Most participants were aged between 35 and 55 years, with no significant differences in age or gender distribution between the two groups ($p = 0.568$ and 0.436 , respectively). The majority of the patient group had also been diagnosed with type 2 diabetes mellitus (T2DM) and had been on hypoglycemic medications (e.g., metformin and sitagliptin) for over three years. Our findings indicate that the serum levels of vitamin D and calcium were significantly lower in the hypothyroid group compared to the control group (12.21 ± 2.02 ng/mL and 4.40 ± 1.24 mg/dL vs 45.53 ± 10.51 ng/mL and 10.88 ± 1.45 mg/dL, $p = 0.008$ and 0.006 , respectively). Moreover,

the serum TSH levels were significantly high in the hypothyroid group (10.98 ± 1.94 vs. 3.63 ± 0.30 mU/L, $p = 0.009$) while the serum levels of T3 (1.02 ± 0.30 vs. 2.94 ± 1.45 pg/dL, $p = 0.001$) and T4 (0.59 ± 0.20 vs. 1.57 ± 0.70 ng/dL, $p = 0.002$) were significantly lower as shown in Table 1.

We observed non-significant differences in the serum levels of vitamin D, calcium, and thyroid profiles between male and female hypothyroid patients ($p > 0.05$; Table 2).

Pearson correlation analysis indicated that the TSH levels of the hypothyroid patients had statistically significant negative correlations with the serum vitamin D and calcium levels ($r = -0.144$, $p = 0.030$ and $r = -0.145$, $p = 0.029$, respectively) as presented in Table 3.

DISCUSSION

Vitamin D deficiency in individuals with hypothyroidism is primarily attributed to either inadequate dietary intake or poor intestinal absorption of vitamin D. To the best of our knowledge, this research is among the few that explore and evaluate the relationship between vitamin D and calcium levels in the context of hypothyroidism in Albayda, Libya. This study was conducted to assess and compare the serum levels of vitamin D and calcium in patients diagnosed with primary hypothyroidism versus healthy individuals without any reported symptoms or history of hypothyroidism or other thyroid-related conditions. The study found that the serum levels of both vitamin D and calcium were significantly lower in the

Table 1. Comparison of thyroid profiles and vitamin D/calcium levels of study participants

Variables	Control group (Mean $\pm$ SD)	Hypothyroid group (Mean $\pm$ SD)	p-value
Age (years)	43.37 $\pm$ 8.47	44.60 $\pm$ 8.90	0.568
Gender, n (%)			
Males	45 (45.0)	30 (30.0)	0.436
Females	55 (55.0)	70 (70.0)	
Serum T3 (pg/dL)	2.94 $\pm$ 1.45	1.02 $\pm$ 0.30	0.001*
Serum T4 (ng/dL)	1.57 $\pm$ 0.70	0.59 $\pm$ 0.20	0.002*
Serum TSH (mU/L)	3.63 $\pm$ 0.30	10.98 $\pm$ 1.94	0.009*
Serum Vit D (ng/mL)	45.53 $\pm$ 10.51	12.21 $\pm$ 2.02	0.008*
Serum Ca ²⁺ (mg/dL)	10.88 $\pm$ 1.45	4.40 $\pm$ 1.24	0.006*

TSH, thyroid stimulating hormone; Vit, vitamin; Ca²⁺, calcium ion

*, means statistically significant differences ($p < 0.05$)

Table 2. Comparison of thyroid profiles and vitamin D/calcium levels of the hypothyroid group

Variables	Hypothyroid group (Mean $\pm$ SD)		p-value
	Males (n = 30)	Females (n = 70)	
Serum T3 (pg/dL)	0.79 $\pm$ 0.32	0.81 $\pm$ 0.42	0.286
Serum T4 (ng/dL)	0.64 $\pm$ 0.34	0.52 $\pm$ 0.26	0.208
Serum TSH (mU/L)	10.98 $\pm$ 1.94	10.92 $\pm$ 1.87	0.362
Serum Vit D (ng/mL)	11.63 $\pm$ 1.87	12.79 $\pm$ 2.17	0.578
Serum Ca ²⁺ (mg/dL)	4.40 $\pm$ 1.24	4.02 $\pm$ 1.15	0.410

TSH, thyroid stimulating hormone; Vit, vitamin; Ca²⁺, calcium ion

Table 3. Correlation coefficients between vitamin D/calcium and TSH of the hypothyroid group

Correlations	Vitamin D (r, p-value)	Calcium (r, p-value)
TSH (mU/L)	$r = -0.144$, $p = 0.030$	$r = -0.145$, $p = 0.029$

TSH, thyroid stimulating hormone

hypothyroid group than in the control group ($p = 0.008$ and 0.006 , respectively). These findings align with those of Ashok et al., who investigated the impact of vitamin D deficiency on the thyroid gland and reported that inadequate vitamin D levels may lead to reduced thyroid hormone production (13). Additionally, vitamin D and calcium serum levels showed significant strong negative correlations with TSH levels in the hypothyroid group ($r = -0.144$, $p = 0.030$ and $r = -0.145$, $p = 0.029$, respectively), suggesting a potential significant correlation between vitamin D/calcium deficiencies and hypothyroidism. Similarly, Li et al. reported that the serum TSH levels of the patient group had significant high negative correlations with the serum vitamin D levels ($r = -0.150$, $p = 0.024$) (14). Consistent with earlier studies, our research found no significant differences in serum vitamin D or calcium levels between males and females in the hypothyroid group ($p = 0.578$ and 0.410 , respectively). For instance, Madkhali et al. reported similar findings in their study on vitamin D status in Saudi Arabia, observing no gender-based variation (15). Similarly, Naseri et al. concluded that vitamin D levels did not differ significantly between men and women in a large-scale study conducted in Iran (16). In line with our results, a study conducted by Qanbar et al. also identified hypovitaminosis D and hypocalcemia in individuals with hypothyroidism, reinforcing the link between these deficiencies and thyroid dysfunction (17). Appunni et al., using a nationally representative sample of 7,943 participants, found that 25.6% of individuals with hypothyroidism had vitamin D deficiency, compared to 20.6% among healthy controls (11). While it is commonly observed in many Muslim-majority countries that women tend to have lower vitamin D levels compared to men—mainly due to clothing practices (e.g., wearing a hijab) and social-religious customs—some studies challenge this assumption. For example, Aghapour et al., in a comprehensive study conducted in Iran, found no significant differences in vitamin D levels between men and women (18). Our own findings align with this conclusion, revealing a high prevalence of severe vitamin D deficiency in both male and female participants. This is supported by earlier research showing an overall vitamin D insufficiency rate of 83.5%, with no significant corre-

lation with gender (19). In addition, our study's findings corroborate those of a study by Faid et al., who also reported a widespread and severe vitamin D deficiency among both sexes (20).

CONCLUSIONS

Our research findings indicate that patients diagnosed with primary hypothyroidism commonly exhibit vitamin D deficiency and hypocalcemia. The significant negative correlations between vitamin D/calcium and TSH levels suggest that the degree and severity of hypothyroidism is significantly associated with serum vitamin D and calcium deficiencies.

Limitations

The small sample size of participants, being a single-center study, the need to measure parathyroid hormone levels (PTH) and to determine its impact on vitamin D and hypothyroidism, and the fact that only one blood sample from each participant was examined, possibly leading to measurement error, are the four main limitations of this study.

Recommendations and future studies

We advise physicians to be aware of potential vitamin D deficiency and hypocalcemia when TSH levels exceed 8 mU/L. Additionally, we recommend regular evaluation of hypothyroid patients' serum levels of calcium and vitamin D and prescription of the proper calcium and vitamin D supplements as part of their treatment plan.

Additional large sample size studies are required to determine whether vitamin D deficiency is a causal factor in the pathogenesis of hypothyroidism or a consequence of the disease. Moreover, further prospective clinical studies should examine the effect of PTH on vitamin D levels and hypothyroidism. Multicenter studies in other regions are needed before our results are widely used. Finally, hypoglycemic medications may lead to vitamin D deficiency in hypothyroid patients, a possible relationship which was not considered in this study. Further studies are required to confirm our results.

ACKNOWLEDGMENTS

We would like to convey our heartfelt thanks to all the participants for their generous assis-

tance and collaboration in making this study possible. Our sincere gratitude is also extended to everyone who enabled us to complete this research. We also wish to acknowledge with great appreciation the essential contribution of the Laboratory Staff at Albayda Medical Center, who allowed us to use the lab equipment and all the required tools in the laboratory.

FUNDING

No funding was received for conducting this research study.

CONFLICTS OF INTEREST

There were no conflicts of interest related to this research article.

AUTHOR CONTRIBUTIONS

N.I.: conceptualization, literature review, data analysis, methodology, data curation, and writing original draft preparation; Y.M.: method validation, data curation, data analysis, software, review & editing, and supervision. Both authors have reviewed and approved the final version of this manuscript submitted for publication.

DATA AVAILABILITY STATEMENT

The data that support the results of this study can be obtained from the corresponding author upon reasonable request.

INSTITUTIONAL REVIEW BOARD STATEMENT

The Medical Ethics Board of Albayda Medical Center granted approval for the study protocol in accordance with the Declaration of Helsinki (protocol code: AMC765/11 and date of approval: November 10th, 2023) prior to study initiation.

INFORMED CONSENT STATEMENT

All participants gave written informed consent for their data to be published.

REFERENCES

1. Institute of Medicine (US) Committee to Review Dietary Reference Intakes for Vitamin D and Calcium. Dietary Reference Intakes for Calcium and Vitamin D. Ross AC, Taylor CL, Yaktine AL, Del Valle HB, editors. Washington (DC): National Academies Press (US); 2011. PMID: 21796828.
2. Kalpana CA, Babita Devi N, Ghosh S, Rashidinejad A. Vitamin D: Chemical Composition, Sources, Delivery, and Uses. Handbook of Food Bioactive Ingredients; 2023.
3. Bikle DD. Vitamin D: Production, metabolism, and mechanism of action. 2025 Jun 15. In: Feingold KR, Adler RA, Ahmed SF, Anawalt B, Blackman MR, Chrousos G, et al. editors. Endotext. South Dartmouth (MA): MDText.com; 2000-. PMID: 25905172.
4. Khan YS, Farhana A. Histology, thyroid gland. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2026.
5. Nussey S, Whitehead S. Endocrinology: An Integrated Approach. Chapter 3, The thyroid gland. Oxford: BIOS Scientific Publishers; 2001. .
6. Młynarska E, Lisińska W, Hossa K, Krupińska N, Jakubowska P, Rysz J, Franczyk B. Vitamin D and chronic disorders: a review of metabolic and cardiovascular diseases. pharmaceuticals (Basel). 2025 Sep 29;18(10):1467.PubMed PMID: 41155582
7. Tang J, Shan S, Li F, Yun P. Effects of vitamin D supplementation on autoantibodies and thyroid function in patients with Hashimoto's thyroiditis: a systematic review and meta-analysis. Medicine. 2023;102:e36759. PubMed PMID: 38206745
8. Todorova M, Geroval D. Vitamin D insufficiency/deficiency as a risk factor for Hashimoto's thyroiditis. Clinica Chimica Acta. 2024;558:118165.
9. Khamisi S, Lundqvist M, Rasmusson AJ, Engström BE, Karlsson FA, Ljunggren Ö. Vitamin D and bone metabolism in Graves' disease: a prospective study. J Endocrinol Invest. 2023;46:425-33.
10. Lanzolla G, Di Matteo L, Comi S, Cosentino G, Menconi F, Maglionico MN, et al. Absence of a relationship between vitamin D and Graves' orbitopathy. J Endocrinol Invest. 2023;46:1717-21.
11. Appunni S, Rubens M, Ramamoorthy V, Saxena A, Tonse R, Veledar E, et al. Association between vitamin D deficiency and hypothyroidism: results from the National Health and Nutrition Examination Survey (NHANES) 2007-2012. BMC Endocr Disord. 2021;21:224. PubMed PMID: 34772378
12. Babić Leko M, Jureško I, Rozić I, Pleić N, Gunjača I, Zemunik T. Vitamin D and the thyroid: a critical review of the current evidence. Int J Mol Sci. 2023;24:3586. PubMed PMID: 36835005
13. Ashok T, Palyam V, Azam AT, Odeyinka O, Alhashimi R, Thoota S, et al. Relationship between vitamin D and thyroid: an enigma. Cureus. 2022;7:267-75.
14. Li Q, Bi R. Relationship between serum 25-hydroxyvitamin D deficiency and thyroid disease in postmenopausal women with type 2 diabetes mellitus. Diabetes Metab Syndr Obes. 2023;16:1407-14.
15. Madkhali Y, Janakiraman B, Alsubaie F, Albalawi O, Alrashidy S, Alturki M, et al. Prevalence and trends of vitamin D deficiency in a Saudi Arabian population: a five-years retrospective study from 2017 to 2021. Front Public Health. 2025; 13:1535980. PubMed PMID: 40356842

16. Naseri M, Mohammadi MH, Soltani NN, Lashgari KH, Dehghani N. Prevalence of vitamin D deficiency and associate factors in healthy Iranian Children and adolescents: a systematic review. *Health Provid.* 2024;4:11-27.
17. Qanbar MM, Soylu S, Teksöz S. The effect of preoperative vitamin D values on hypocalcemia after total thyroidectomy. *Turkish Journal of Surgery.* 2024;40: 296-302.
18. Aghapour B, Kheirouri S, Alizadeh M, Khodayari-Zarnaq R. Vitamin D deficiency prevention policies in Iran: a retrospective policy analysis. *Front Nutr.* 2023;10:1249402. PubMed PMID: 37680901
19. Salman S, Khouzami M, Harb M, Saleh B, Boushnak MO, Moussa MK, et al. Prevalence and predictors of vitamin D inadequacy: a sample of 2,547 patients in a mediterranean country. *Cureus.* 2021;13:e14881. PubMed PMID: 34104607
20. Faïd FE, Alsheekh AM, Abais MF, Eljamay SM. Vitamin D deficiency relationship with age and gender. *Derna Academy Journal for Applied Sciences.* 2024;3:153-60.