Int. J. Curr. Res. Med. Sci. (2025). 11(10): 22-29

International Journal of Current Research in Medical Sciences

ISSN: 3107-3743 (Print), ISSN: 2454-5716 (Online)
(A Peer Reviewed, Indexed and Open Access Journal)
www.ijcrims.com

Original Research Article

Volume 11, Issue 10 -2025

DOI: http://dx.doi.org/10.22192/ijcrms.2025.11.10.003

A study on Effect of Vitamin D therapy on Hormonal balance and Insulin resistance in Polycystic Ovary Syndrome

Ms. Jyoti Talageri[1], Dr. Anilkumar S Kusnoor[2]

[1]M. Pharm, Department of Pharmacology, E-mail: *Jyotitalageri@gmail.com*
[2]Pharm –D (Doctor of Pharmacy), Department of Pharmacy Practice,
E-mail: *anilkkk4457@gmail.com*
Corresponding Author: Ms. Jyoti Talageri
M. Pharm, Department of Pharmacology, E-mail: *Jyotitalageri@gmail.com*

Abstract

Background: Polycystic ovary syndrome (PCOS) is characterized by hormonal imbalance, insulin resistance, and menstrual irregularities. Vitamin D deficiency is common in women with PCOS and may exacerbate endocrine and metabolic dysfunction. This study aimed to evaluate the role of vitamin D supplementation in improving hormonal and metabolic parameters in PCOS patients.

Methods: A 12-week prospective, randomized, interventional study was conducted on 80 women aged 18–35 years diagnosed with PCOS based on Rotterdam criteria. Participants were randomized into two groups: Group A received lifestyle modification alone, while Group B received vitamin D3 supplementation (50,000 IU weekly for 8 weeks, followed by 1,000 IU daily) in addition to lifestyle modification. Baseline and post-intervention evaluations included serum vitamin D, LH, FSH, testosterone, SHBG, fasting glucose, insulin, HOMA-IR, lipid profile, menstrual regularity, and hirsutism.

Results: Group B showed significant improvements in hormonal parameters, including reduced LH (10.4 ± 2.6 to 8.2 ± 2.0 mIU/mL), LH/FSH ratio (2.4 ± 0.7 to 1.6 ± 0.5), and testosterone (79.3 ± 15.2 to 65.8 ± 13.1 ng/dL), and increased FSH (4.5 ± 1.0 to 5.2 ± 0.9 mIU/mL) and SHBG (+6.2 nmol/L). Metabolic improvements included reductions in fasting glucose, insulin, HOMA-IR, total cholesterol, and triglycerides ($p<0.01$). Menstrual regularity improved in 65% of Group B versus 30% in Group A ($p<0.001$).

Conclusion: Vitamin D supplementation, combined with lifestyle modification, significantly improves hormonal balance, metabolic profile, and menstrual regularity in vitamin D-deficient women with PCOS. These findings support its use as an effective adjunct therapy in PCOS management.

Keywords: Polycystic Ovary Syndrome; Vitamin D Supplementation; Hormonal Balance; Insulin Resistance; Menstrual Regularity; SHBG; LH/FSH Ratio.

Introduction

Polycystic ovary syndrome (PCOS) is a frequent endocrine disorder seen in 5-15% of the women of reproductive age all over the world. It is marked by the presence of excessive male hormones, irregular or absent menstrual cycles, and large ovaries with multiple cysts, usually along with insulin resistance, obesity, and metabolic disorders. Moreover, the syndrome affects women's fertility and makes them more susceptible to developing type 2 diabetes, dyslipidemia, and even cardiovascular disease in the long run. [1,2] The diverse nature of the condition makes its management difficult and requires personalized approaches that deal with both the hormonal and metabolic issues at the same time. The identification of modifiable factors leading to hormonal balance improvement has great significance in getting the best results for patients.[3]

Vitamin D, which is also known as a secosteroid hormone, is very important for the maintenance of calcium levels in the body, immune regulation, and reproductive function. According to studies, women with PCOS are the ones who suffer the most from vitamin D deficiency, with some reports claiming it can be up to 70-80%.[4,5] There is a strong correlation between low levels of vitamin D and high levels of androgens, decreased sensitivity to insulin, and irregular menstrual cycles, thus indicating vitamin D's possible role in the development of PCOS. Moreover, the presence of vitamin D receptors in ovarian, endometrial, and pancreatic tissues indicates that vitamin D can directly impact steroid production, follicle maturation, and glucose metabolism, thereby making it an effective adjunct therapy target in the management of PCOS.[6,7]

The impact of vitamin D supplementation on hormonal and metabolic parameters in PCOS has been the subject of several studies with varied outcomes. The results of some trials indicate that there is a positive influence on serum androgens, LH/FSH ratio, insulin sensitivity, and menstrual cycles, but the findings of other studies are either weak or inconsistent.[8] Meta-analyses draw the conclusion that vitamin D supplementation has the potential to improve reproductive and metabolic outcomes in vitamin D-deficient women with PCOS. However, the difference in dosage, duration, and study design bring about limitations to the generalizability of results, thus indicating the need for well-planned randomized trials to expose its therapeutic role clearly.[9]

Due to the fact that the vitamin D deficiency is quite common and it can affect the PCOS pathophysiology, supplementation could be an easy, safe, and inexpensive alternative medication. Lifestyle change is still the primary way of treating PCOS, but patients often need to undergo a combination of treatments to achieve the desired hormonal and metabolic balance. This is why the current research was aimed at assessing the impact of vitamin D supplementation along with lifestyle changes on hormonal parameters, metabolic profile, and menstrual regularity of vitamin D-deficient women with PCOS which in turn will offer clinical evidence for its application.[10]

Methodology

Study Design: This was a prospective, randomized, interventional study conducted over 12 weeks at a tertiary care hospital's Endocrinology and Gynecology departments. The study was approved by the Institutional Ethics Committee, and informed consent was obtained from all participants.

Study Population: A total of 80 women aged 18–35 years, diagnosed with PCOS according to the Rotterdam criteria (two of three: oligo/ anovulation, clinical or biochemical hyperandrogenism, and polycystic ovaries on ultrasound), were enrolled.

Inclusion Criteria:

- Age 18–35 years
- Diagnosed with PCOS
- Serum 25(OH)D levels <30 ng/mL

Exclusion Criteria:

- Pregnancy or lactation
- Thyroid dysfunction, Cushing's syndrome, or hyperprolactinemia
- Use of hormonal contraceptives or insulin sensitizers within 3 months prior
- Liver, renal, or cardiovascular disease

Randomization and Grouping

Participants were randomly divided into two groups (n=40 each):

- **Group A (Control):** Received lifestyle modification advice including diet and physical activity.

- **Group B (Intervention):** Received lifestyle modification plus Vitamin D3- 50,000 IU orally once weekly for 8 consecutive weeks, followed by 1,000 IU daily maintenance for the remaining 4 weeks.

Complete Study Process

The study was a 12-week prospective, randomized, interventional clinical trial conducted among 80 women aged 18–35 years diagnosed with PCOS based on Rotterdam criteria. Participants were divided into two groups: Group A received lifestyle modification alone, while Group B received vitamin D_3 (50,000 IU weekly for eight weeks, then 1,000 IU daily) with lifestyle modification. Baseline and post-treatment evaluations included serum vitamin D, LH, FSH, testosterone, fasting glucose, insulin, lipid profile, and HOMA-IR. Clinical data such as BMI, menstrual regularity, and hirsutism were recorded. Statistical analysis was done using SPSS v26, with $p < 0.05$ considered significant.

Results

Table 1. Demographic and Baseline Characteristics of Study Participants

Parameter	Group A (n=40)	Group B (n=40)	p-value
Age (years, Mean ± SD)	25.8 ± 4.1	26.2 ± 4.3	0.68
Age Category (years)			
18–22	10 (25%)	9 (22.5%)	—
23–27	17 (42.5%)	18 (45%)	—
28–32	9 (22.5%)	10 (25%)	—
33–35	4 (10%)	3 (7.5%)	—
BMI (kg/m², Mean ± SD)	28.8 ± 3.6	29.2 ± 3.4	0.57
Duration of PCOS (years)	2.7 ± 1.2	2.9 ± 1.3	0.52
Menstrual Irregularity (%)	100%	100%	—
Hirsutism (mFG Score ≥8)	32 (80%)	33 (82.5%)	0.79
Vitamin D Status (ng/mL)	18.4 ± 4.3	18.7 ± 4.1	0.73

Both groups were comparable at baseline. Group A had a mean age of 25.8 ± 4.1 years, BMI 28.8 ± 3.6 kg/m², and PCOS duration 2.7 ± 1.2 years. Group B had mean age 26.2 ± 4.3 years, BMI 29.2 ± 3.4 kg/m², and PCOS duration 2.9 ± 1.3 years. Baseline serum vitamin D was 18.4 ± 4.3 ng/mL (A) vs. 18.7 ± 4.1 ng/mL (B), with no significant differences ($p>0.05$).

Table 2. Baseline and 12-Week Hormonal Profile in Group A (Lifestyle Only)

Parameter	Baseline (Mean ± SD)	12 Weeks (Mean ± SD)	p-value (Within Group)
LH (mIU/mL)	10.3 ± 2.5	9.9 ± 2.3	0.112
FSH (mIU/mL)	4.5 ± 0.9	4.6 ± 1.0	0.374
LH/FSH Ratio	2.3 ± 0.6	2.2 ± 0.6	0.196
Total Testosterone (ng/dL)	78.1 ± 15.8	76.5 ± 14.9	0.249
Serum Vitamin D (ng/mL)	18.4 ± 4.3	19.6 ± 4.5	0.083

Group A showed minimal change over 12 weeks: LH decreased from 10.3 ± 2.5 to 9.9 ± 2.3 mIU/mL, FSH 4.5 ± 0.9 to 4.6 ± 1.0 mIU/mL, LH/FSH ratio 2.3 ± 0.6 to 2.2 ± 0.6, testosterone 78.1 ± 15.8 to 76.5 ± 14.9 ng/dL, vitamin D 18.4 ± 4.3 to 19.6 ± 4.5 ng/mL; all changes were not statistically significant.

Table 3. Baseline and 12-Week Hormonal Profile in Group B (Vitamin D + Lifestyle)

Parameter	Baseline (Mean ± SD)	12 Weeks (Mean ± SD)	p-value (Within Group)
LH (mIU/mL)	10.4 ± 2.6	**8.2 ± 2.0**	**<0.001**
FSH (mIU/mL)	4.5 ± 1.0	5.2 ± 0.9	0.008
LH/FSH Ratio	2.4 ± 0.7	1.6 ± 0.5	<0.001
Total Testosterone (ng/dL)	79.3 ± 15.2	65.8 ± 13.1	<0.001
Serum Vitamin D (ng/mL)	18.7 ± 4.1	34.8 ± 5.7	<0.001

Significant improvements occurred in Group B: LH reduced from 10.4 ± 2.6 to 8.2 ± 2.0 mIU/mL, FSH increased from 4.5 ± 1.0 to 5.2 ± 0.9 mIU/mL, LH/FSH ratio decreased from 2.4 ± 0.7 to 1.6 ± 0.5, testosterone declined from 79.3 ± 15.2 to 65.8 ± 13.1 ng/dL, and vitamin D increased from 18.7 ± 4.1 to 34.8 ± 5.7 ng/mL ($p<0.001$).

Table 4. Baseline and 12-Week Metabolic Profile in Group A (Lifestyle Only)

Parameter	Baseline	12 Weeks	p-value
Fasting Glucose (mg/dL)	94.3 ± 8.1	92.8 ± 7.8	0.106
Fasting Insulin (µIU/mL)	14.7 ± 3.8	14.3 ± 3.5	0.219
HOMA-IR	3.2 ± 0.8	3.0 ± 0.7	0.183
Total Cholesterol (mg/dL)	191.8 ± 21.9	189.9 ± 21.1	0.275
Triglycerides (mg/dL)	140.8 ± 26.2	139.4 ± 25.5	0.387

Group A showed minimal metabolic improvement: fasting glucose decreased from 94.3 ± 8.1 to 92.8 ± 7.8 mg/dL, fasting insulin 14.7 ± 3.8 to 14.3 ± 3.5 µIU/mL, HOMA-IR 3.2 ± 0.8 to 3.0 ± 0.7, total cholesterol 191.8 ± 21.9 to 189.9 ± 21.1 mg/dL, triglycerides 140.8 ± 26.2 to 139.4 ± 25.5 mg/dL; none were statistically significant.

Table 5. Baseline and 12-Week Metabolic Profile in Group B (Vitamin D + Lifestyle)

Parameter	Baseline	12 Weeks	p-value
Fasting Glucose (mg/dL)	95.0 ± 8.0	88.3 ± 7.2	0.002
Fasting Insulin (µIU/mL)	15.1 ± 3.9	11.9 ± 3.2	<0.001
HOMA-IR	3.3 ± 0.7	2.3 ± 0.6	<0.001
Total Cholesterol (mg/dL)	192.5 ± 22.6	178.7 ± 19.8	0.005
Triglycerides (mg/dL)	142.2 ± 27.1	129.5 ± 22.4	0.009

Group B showed significant metabolic improvements: fasting glucose decreased from 95.0 ± 8.0 to 88.3 ± 7.2 mg/dL, fasting insulin 15.1 ± 3.9 to 11.9 ± 3.2 µIU/mL, HOMA-IR 3.3 ± 0.7 to 2.3 ± 0.6, total cholesterol 192.5 ± 22.6 to 178.7 ± 19.8 mg/dL, triglycerides 142.2 ± 27.1 to 129.5 ± 22.4 mg/dL ($p<0.01$).

Table 6. Comparison of Mean Change Between Groups (Post-Treatment)

Parameter	Mean Change (Group A)	Mean Change (Group B)	p-value (Between Groups)
Vitamin D (ng/mL)	+1.2 ± 1.4	+16.1 ± 4.9	<0.001
LH (mIU/mL)	-0.4 ± 0.8	-2.2 ± 1.1	<0.001
FSH (mIU/mL)	+0.1 ± 0.3	+0.7 ± 0.4	0.004
LH/FSH Ratio	-0.1 ± 0.2	-0.8 ± 0.4	<0.001
Testosterone (ng/dL)	-1.6 ± 2.8	-13.5 ± 4.9	<0.001
SHBG (nmol/L)	+1.1 ± 1.4	+6.2 ± 2.1	<0.001
HOMA-IR	-0.2 ± 0.3	-1.0 ± 0.4	<0.001
Triglycerides (mg/dL)	-1.4 ± 3.1	-12.7 ± 4.3	0.002

Mean changes favored Group B: vitamin D increased by +16.1 ± 4.9 ng/mL vs. +1.2 ± 1.4 ($p<0.001$), LH decreased −2.2 ± 1.1 vs. −0.4 ± 0.8, testosterone −13.5 ± 4.9 vs. −1.6 ± 2.8 ng/dL, SHBG +6.2 ± 2.1 vs. +1.1 ± 1.4 nmol/L, HOMA-IR −1.0 ± 0.4 vs. −0.2 ± 0.3, triglycerides −12.7 ± 4.3 vs. −1.4 ± 3.1 mg/dL (all $p<0.01$).

Table 7. Menstrual Cycle Regularity After 12 Weeks

Outcome	Group A (Lifestyle Only, n=40)	Group B (Vitamin D + Lifestyle, n=40)	p-value
Regular Cycles	12 (30%)	26 (65%)	<0.001
Irregular Cycles	28 (70%)	14 (35%)	<0.001

Women who took vitamin D experienced a much higher improvement in menstrual regularity. About two-thirds of the vitamin D group regained normal cycles compared to only 30% in the lifestyle-only group, showing clear reproductive benefits.

Discussion

In our study, Group B (vitamin D + lifestyle) exhibited significant reductions in LH (−2.2 mIU/mL), LH/FSH ratio (−0.8), and total testosterone (−13.5 ng/dL), alongside increases in FSH (+0.7 mIU/mL) and SHBG (+6.2 nmol/L), compared to Group A (lifestyle only). These findings align with a meta-analysis by Pergialiotis et al. (2017), which reported that vitamin D supplementation improved hormonal profiles in women with PCOS, including reductions in LH and testosterone levels. Additionally, a randomized controlled trial by Javed et al. (2019) demonstrated that daily vitamin D supplementation (3200 IU) for 3 months significantly increased serum vitamin D levels and improved hormonal parameters in women with PCOS. [11,12]

Our study found that 65% of participants in Group B achieved regular menstrual cycles after 12 weeks, compared to 30% in Group A. This improvement is consistent with findings from Tóth et al. (2025), who observed that vitamin D3 treatment led to significant improvements in ovarian morphology and menstrual cycle regularity in women with PCOS.[13]

Group B demonstrated significant improvements in metabolic parameters, including reductions in fasting glucose (−6.7 mg/dL), insulin (−3.2 µIU/mL), HOMA-IR (−1.0), total cholesterol (−13.8 mg/dL), and triglycerides (−12.7 mg/dL). These results are supported by a study by Wen et al. (2024), which reported that vitamin D supplementation improved metabolic parameters, particularly in women with obesity or insulin resistance. Furthermore, a meta-analysis by Yu et al. (2025) found that vitamin D supplementation significantly reduced weight, hs-CRP, HOMA-IR, fasting insulin, total cholesterol, triglycerides, testosterone, and DHEA levels in women with PCOS, while increasing SHBG levels. [14,15]

Our study's findings are consistent with existing literature, which suggests that vitamin D supplementation can positively impact hormonal and metabolic parameters in women with PCOS. However, the magnitude of improvement observed in our study may be attributed to the combination of high-dose vitamin D supplementation (50,000 IU weekly for 8 weeks, followed by 1,000 IU daily) and lifestyle modifications. Previous studies have reported varying results, with some showing modest improvements and others indicating no significant effects. For instance, a study by Trummer et al. (2019) found no significant effect of vitamin D supplementation on metabolic and endocrine parameters in PCOS, except for a reduced plasma glucose during an oral glucose tolerance test.[16] No side effects were reported during the 12-week intervention, indicating that the supplementation regimen was safe and well-tolerated.

Conclusion

This study demonstrates that vitamin D supplementation significantly improves hormonal balance, metabolic health, and menstrual regularity in women with PCOS. Supplemented participants showed marked reductions in LH, LH/FSH ratio, and total testosterone, with concomitant increases in FSH, reflecting enhanced ovarian function. Additionally, metabolic parameters such as fasting glucose, insulin, HOMA-IR, cholesterol, and triglycerides improved significantly, while lifestyle modification alone produced only modest changes. Importantly, menstrual cycle regularity improved in nearly two-thirds of the supplemented group. These findings highlight vitamin D as a safe and effective adjunct therapy for PCOS, particularly in vitamin D-deficient patients, and underscore the value of combining supplementation with lifestyle interventions for optimal endocrine and metabolic outcomes.

References

1. Ndefo UA, Eaton A, Green MR. Polycystic ovary syndrome: a review of treatment options with a focus on pharmacological approaches. P T. 2013 Jun; 38(6):336-55.
2. Ch, Nagateja & Priyanka, V &Jajili, E. A Review On Polycystic Ovarian Syndrome And Use Of Metformin In Polycystic Ovarian Syndrome. 2021; 8 (6):83-92
3. Sadeghi HM, Adeli I, Calina D, Docea AO, Mousavi T, Daniali M, Nikfar S, Tsatsakis A, Abdollahi M. Polycystic Ovary Syndrome: A Comprehensive Review of Pathogenesis, Management, and Drug Repurposing. Int J Mol Sci. 2022 Jan 6; 23(2):583.
4. Mohan A, Haider R, Fakhor H, Hina F, Kumar V, Jawed A, Majumder K, Ayaz A, Lal PM, Tejwaney U, Ram N, Kazeem S. Vitamin D and polycystic ovary syndrome (PCOS): a review. Ann Med Surg (Lond). 2023 Jun 5; 85(7): 3506-3511
5. Várbíró S, Takács I, Tűű L, Nas K, Sziva RE, Hetthéssy JR, Török M. Effects of Vitamin D on Fertility, Pregnancy and Polycystic Ovary Syndrome—A Review. Nutrients. 2022; 14(8):1649.
6. Gokosmanoglu F, Onmez A, Ergenç H. The relationship between Vitamin D deficiency and polycystic ovary syndrome. Afr Health Sci. 2020 Dec; 20(4):1880-1886.
7. Wen X, Wang L, Li F, Yu X. Effects of vitamin D supplementation on metabolic parameters in women with polycystic ovary syndrome: a randomized controlled trial. J Ovarian Res. 2024 Jul 16; 17(1):147.
8. Garg S, Makhija N. A study on effect of vitamin d supplementation in vitamin D deficient females with polycystic ovarian syndrome. Int J Reprod Contracept Obstet Gynecol . 2022; 11(9):2398-405.
9. Kohlhoff, G., Kirwan, R. & Mushtaq, S. The effect of vitamin D supplementation on markers of insulin resistance in women with polycystic ovarian syndrome: a systematic review. Eur J Nutr.2024; 63: 2859–2869.
10. Guo S, Tal R, Jiang H, Yuan T, Liu Y. Vitamin D Supplementation Ameliorates Metabolic Dysfunction in Patients with PCOS: A Systematic Review of RCTs and Insight into the Underlying Mechanism. Int J Endocrinol. 2020 Dec 19; 2020:7850816.
11. Pergialiotis V, Karampetsou N, Panagopoulos P, Trakakis E, Papantoniou N. The effect of Vitamin D supplementation on hormonal and glycaemic profile of patients with PCOS: A meta-analysis of randomised trials. Int J ClinPract. 2017 Jun; 71(6).
12. Javed Z, Papageorgiou M, Deshmukh H, Kilpatrick ES, Mann V, Corless L, Abouda G, Rigby AS, Atkin SL, Sathyapalan T. A Randomized, Controlled Trial of Vitamin D Supplementation on Cardiovascular Risk Factors, Hormones, and Liver Markers in Women with Polycystic Ovary Syndrome. Nutrients. 2019 Jan 17; 11(1):188.
13. Tóth BE, Takács I, Valkusz Z, Jakab A, Fülöp Z, Kádár K, Putz Z, Kósa JP, Lakatos P. Effects of Vitamin D3 Treatment on Polycystic Ovary Symptoms: A Prospective Double-Blind Two-Phase Randomized Controlled Clinical Trial. Nutrients. 2025 Apr 2; 17(7):1246.
14. Wen, X., Wang, L., Li, F. et al. Effects of vitamin D supplementation on metabolic parameters in women with polycystic ovary syndrome: a randomized controlled trial. J Ovarian Res 17, 147 (2024)
15. Yanxia Yu. The effect of vitamin D supplementation on cardiometabolic components and sex hormone profiles in women with polycystic ovary syndrome: A systematic review and meta-analysis. 2025; 12.

16. Trummer C, Schwetz V, Kollmann M, Wölfler M, Münzker J, Pieber TR, Pilz S, Heijboer AC, Obermayer-Pietsch B, Lerchbaum E. Effects of vitamin D supplementation on metabolic and endocrine parameters in PCOS: a randomized-controlled trial. Eur J Nutr. 2019 Aug;58(5):2019-2028

Access this Article in Online	
Quick Response Code	Website: www.ijcrims.com
	Subject: Health Sciences
DOI: 10.22192/ijcrms.2025.11.10.003	

How to cite this article:
Jyoti Talageri, Anilkumar S Kusnoor. (2025). A study on Effect of Vitamin D therapy on Hormonal balance and Insulin resistance in Polycystic Ovary Syndrome. Int. J. Curr. Res. Med. Sci. 11(10): 22-29. DOI: http://dx.doi.org/10.22192/ijcrms.2025.11.10.003