SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Khan and Pande, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.1.37

Research Article

open access

Impact of Vitamin D Supplementation on Clinical Features of PCOS Patients with Vitamin D Deficiency

Nida Khan[1]*, Shubha Pande[2]

[1]Senior Resident, Department of Obstetrics and Gynecology, United Institute of Medical Sciences, Prayagraj, India
[2]Consultant, Department of Obstetrics and Gynaecology, Kamala Nehru Memorial Hospital, Allahabad, India

***Address for Correspondence:** Dr. Nida Khan, Department of Obstetrics and Gynaecology, United Institute of Medical Sciences, Prayagraj, India
E-mail: drnidakhan22nov@gmail.com

Received: 26 Aug 2023/ Revised: 23 Oct 2023/ Accepted: 03 Dec 2023

ABSTRACT

Background: Polycystic ovarian syndrome (PCOS) is a common endocrinopathy affecting women of reproductive age group. It is a multifactorial disease characterized by different levels of anomalies related to reproduction and metabolism, including insulin resistance (IR), hyperinsulinemia, dyslipidaemia, and obesity. Vitamin D impacts physiological processes, including calcium homeostasis, glucose homeostasis, and bone metabolism. The effect of supplementation with vitamin D on the clinical traits of vitamin D-deficient PCOS patients was investigated in this study.

Methods: A prospective observational study was conducted on 129 PCOS patients aged 18–35 at Kamala Nehru Memorial Hospital, Allahabad, during May 2017–2018. Following screening for inclusion and exclusion criteria and gaining consent, all women meeting the Rotterdam criteria for PCOS had a comprehensive clinical examination, including waist circumference, body weight, body mass index (BMI), and waist-hip ratio (WHR). Vitamin D supplementation was prescribed for six months, and its effect on clinical characteristics was observed. SPSS version 16 was used to assess the data and examine the impact of treatment; a paired t-test was used.

Results: The mean BMI (p=0.176) and change in weight (p=0.582) were reduced post-six months of supplementation with vitamin D, showing a non-significant association of BMI and weight with vitamin D supplementation. Similarly, the mean WHR showed no change (p=0.253).

Conclusion: The clinical parameters, including weight, BMI, and WHR, remained unchanged after vitamin D supplementation. Although vitamin D intake did not influence clinical characteristics, its positive benefits are implied by the improvement in risk measures and the absence of side effects.

Key-words: Polycystic ovary syndrome, Body mass index, Obesity, Rotterdam criteria, Waist circumference, Waist-hip ratio

INTRODUCTION

With a prevalence of 4–10%, PCOS is one of the most prevalent, complex, and varied endocrinopathies among women of reproductive age group [1]. It is linked to metabolic disorders such as obesity, dyslipidemia, hyperinsulinemia, and insulin resistance (IR), in addition to gynaecological and hyperandrogenic characteristics.

How to cite this article
Khan N, Pande S. Impact of Vitamin D Supplementation on Clinical Features of PCOS Patients with Vitamin D Deficiency. SSR Inst Int J Life Sci., 2024; 10(1): 3699-3704.

Access this article online
https://iijls.com/

Overweight and obesity affect almost half of PCOS patients, and they are important factors in IR and perhaps androgen hypersecretion in affected women [2]. The current obesity epidemic points to an increase in the prevalence of PCOS in future. This may impact the morbidity and mortality rates related to cardiovascular disease. PCOS has consequently grown as a serious public health issue.

Rotterdam criteria-2003 [3] states that more than 25% of reproductive women in India are suffering from PCOS. According to these criteria, any two of the following three characteristics must be present in a woman to be diagnosed as a PCOS patient.

● Anovulation or oligo-ovulation;

● Indications of hyperandrogenism in the body, either clinically or biochemically, or both;

● Polycystic ovaries, excluding other etiologies (follicle count of 12 or higher or ovarian volume greater than 10 ml on ultrasonography).

Women with PCOS, especially those with central obesity, are more likely to develop metabolic syndrome and IR since PCOS and obesity are associated. Over 80% of PCOS female patients are obese. The increased genetic predisposition to obesity in women with PCOS may account for the relationship between obesity and disease.

The frequency of PCOS patients has increased significantly in recent years. Although the cause is unknown, it could be attributed to genetics, eating habits, or obesity. The increased rate of obesity among PCOS patients is largely due to high-calorie diets and insufficient exercise. PCOS is more common in obese women in comparison to non-obese ones [4].

According to the International Diabetes Federation (2005) [5], central obesity (assessed by waist circumference) is a key element of the metabolic syndrome [6]. In their study, Faraji *et al.* [7] found an association between increased WHR and decreased vitamin D levels. A WHR of 0.85 or more shows the body's fat distribution, leading to glucose intolerance, hyperinsulinemia, increased androgen, and diabetes mellitus. The WHR is strongly correlated with obesity obesity-related risk variables. Obesity is one of the key characteristics of PCOS, and WHR>0.8 suggests obesity. Research has indicated a positive relationship between vitamin D insufficiency, obesity, and WHR [8].

Vitamin D is a fat-soluble vitamin necessary for bone metabolism and calcium homeostasis. It affects glucose and insulin metabolism, and an elevated risk of IR is linked to a low vitamin D level. Women with PCOS experience IR and metabolic abnormalities, which may relate to vitamin D metabolism. Patients with PCOS frequently have vitamin D insufficiency, which exacerbates metabolic problems. The association between vitamin D deficiency, PCOS and obesity is well-established, and obesity is considered a risk element for vitamin D deficiency. [9,10]. Vitamin D supplementation has gained attention recently, considering the connection between Vitamin D and PCOS. However, few convincing pieces of evidence are available to demonstrate the relationship between vitamin D supplementation and PCOS. This study evaluated the impact of vitamin D supplementation on the clinical traits of vitamin D-deficient PCOS patients.

MATERIALS AND METHODS

Research Design- All PCOS patients aged 18–35 who visited Kamala Nehru Memorial Hospital's outpatient department (OPD) in Allahabad, India, between May 2017 and May 2018 were the subjects of a prospective observational study. 129 PCOS patients (married and unmarried) were screened based on inclusion and exclusion criteria. About 122 patients fulfilling the study criteria and consented to participation were included. Out of these, 98 patients were vitamin D deficient. Among these, 57 patients were vitamin D deficient as well as obese and overweight. Five patients refused to participate in the study, 3 patients did not return for follow-up, and one was non-compliant. So, our sample size came out to be 48.

Inclusion criteria

- ✓ Rotterdam criteria were employed to detect PCOS patients.
- ✓ Onset of maturation (spontaneous).
- ✓ Regular sexual maturation.
- ✓ Aged between 18 and 35 years

Overweight or obese patients with Vitamin D deficiency were considered for the sample group.

Exclusion criteria- Patients with thyroid dysfunction, hyperprolactinemia, hypertensive disorders, hyperlipidaemia, diabetes mellitus, late-onset congenital adrenal hyperplasia, Cushing's disease, anti-epileptics, patients on oral contraceptive pills, patients on steroids (oral/inhalers) were excluded from the study.

All the study participants were informed about the nature, conduct and all possible risks and rights before the initiation of the study. An informed written consent was obtained from each participant. A detailed history was taken from all the participants of the study. Estimation of serum 25 hydroxyvitamin D level and BMI was done for all the study participants. Clinical assessments, including weight, BMI, waist circumference and WHR, were made at baseline and repeated after six months of treatment.

SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Khan and Pande, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.1.37

After a gentle exhalation, the waist circumference measurement was taken halfway between the iliac crest and the lowest rib. The cut-off point was a waist circumference of 85 cm or more. The widest part of the buttocks should be measured for the hip circumference, with the tape parallel to the ground. The following formula was used to compute BMI:

$$\text{BMI} = \frac{\text{Mass (Kg)}}{\text{Height (m)}^2}$$

All subjects received lifestyle modification. They were advised not to adhere to a calorie-deficit diet plan but to reduce their intake of fat and carbohydrates and alter their eating habits. They were not monitored and advised to moderate-to-intense exercise daily for 30 minutes. All the participants were prescribed Vitamin D 2000 I.U./day, and outcomes were measured based on parameters like weight, BMI, and WHR after six months.

Statistical Analysis- Each participant underwent the same procedure after six months of treatment. The analysis of the data was done with SPSS version 16. The paired t-test was used to analyse the impact of treatment both before and after the trial was finished. P-values less than 0.05 were considered statistically significant.

Ethical Approval- The Ethical Committee of the Department of Obstetrics and Gynaecology approved the study at Kamala Nehru Memorial Hospital, Allahabad, India. Before the study, each patient gave their full informed consent.

RESULTS

Women between 18 and 35 years of age visiting the OPD at Kamala Nehru Memorial Hospital in Allahabad, India, participated in the study. After a detailed history, all women fulfilling Rotterdam criteria for PCOS were subjected to clinical assessment, including weight, BMI, waist circumference, and WHR. Out of 129 patients presented to the OPD, 122 patients fulfilled the criteria for inclusion and exclusion for the study. Fig. 1 illustrates that of these 122 cases, 98 individuals who were vitamin D deficient PCOS cases and met inclusion and exclusion criteria had low vitamin D levels.

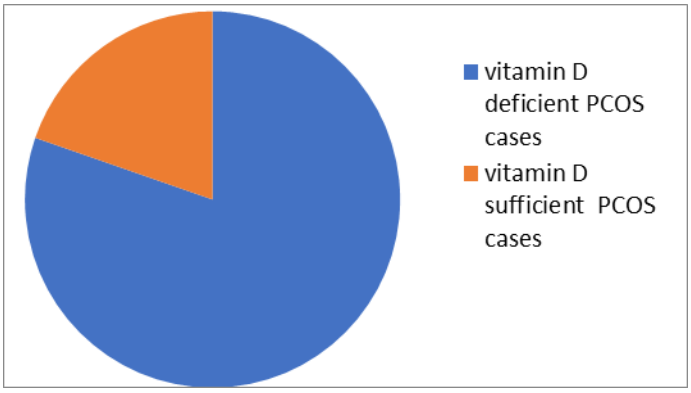

Fig. 1: Prevalence of Vitamin D deficiency in PCOS cases.

Vitamin D levels varied among the 122 patients: 5.73% had levels below 10 ng/ml, 40.16% between 10 and 19.9 ng/ml, 34.42% between 20 and 29.9 ng/ml, and 19.67% with normal levels, or more than 30 ng/ml.

Among the total 98 (25 hydroxy vitamin D deficient) PCOS women, 57 cases (58.16%) were overweight and obese (BMI>25), and 41 cases (41.84%) had normal BMI.

Vitamin D supplementation of 2000 IU for six months was prescribed daily to all participants (i.e. vitamin D deficient overweight and obese PCOS women), and the effect of treatment on clinical characteristics was observed.

Fig. 2 represents the effect of vitamin D supplementation on vitamin D levels of PCOS patients. Before taking vitamin D supplements, 14.58% of cases had vitamin D levels less than 10 ng/ml, 47.91% had levels between 10 and 19.9 ng/ml, and 37.5% had levels between 20 and 29.9 ng/ml. After six months of vitamin D supplementation, no cases had vitamin D levels less than 10 ng/ml, 12.5% had levels between 10 and 19.9 ng/ml, and 87.5% had levels between 20 and 29.9 ng/ml. The mean vitamin D levels increased significantly from (16.91±7.13) to (29.96 ±6.68).

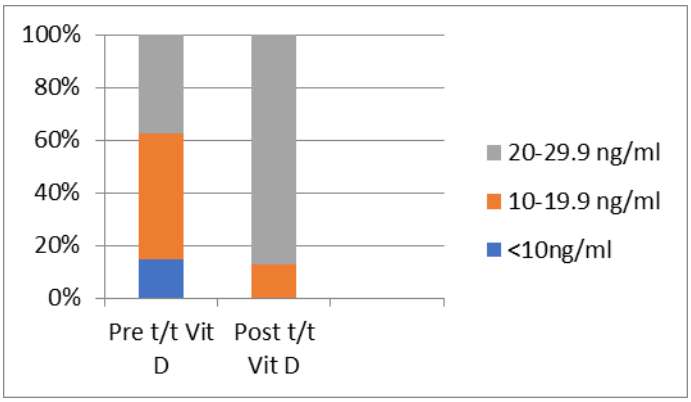

Fig. 2: Effect of vitamin D supplementation on vitamin D levels among PCOS patients.

SSR Institute of International Journal of Life Sciences
ISSN (O): 2581-8740 | ISSN (P): 2581-8732
Khan and Pande, 2024
DOI: 10.21276/SSR-IIJLS.2024.10.1.37

Fig. 3 shows that initially, 43 women (89.58%) had a BMI in the range of 25–29.9 kg/m^2, and 5 women (10.42%) had a BMI in the range >30 kg/m^2. After vitamin D supplementation for six months, 44 women (91.66%) had a BMI in the range of 25–25.9 kg/m^2, and 4 women (8.54%) had a BMI in the range of>30 kg/m^2. The mean BMI was 27.50±1.73, which after treatment with vitamin D for six months was 27.40±1.67. The paired t-test was 1.372, and the p-value was 0.176, indicating a minimal impact of vitamin D treatment on BMI.

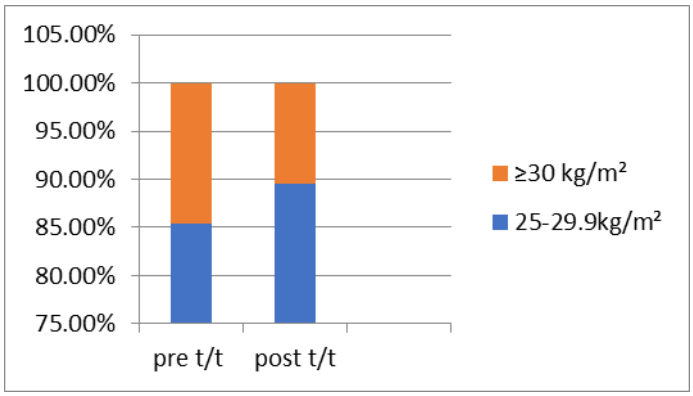

Fig. 3: Effect on BMI before and after vitamin D supplementation.

Fig. 4 shows that 3 women (6.25%) were in the weight range of <60 kg, 37 women (77.08%) were in the weight range of 60–69.9 kg, and 8 women (16.66%) were >70 kg in weight before treatment. Post-treatment, 5 women (10.41%) were in the weight <60 kg, 38 women (79.16%) were in the weight range 60–69.9 kg, and 5 women (10.41%) were >70 kg. After 6 months of treatment with vitamin D, the mean weight changed from 64.68±4.31 to 64.54±4.01. The paired t-test was 0.55, indicating a non-significant change in weight with a p-value of 0.58.

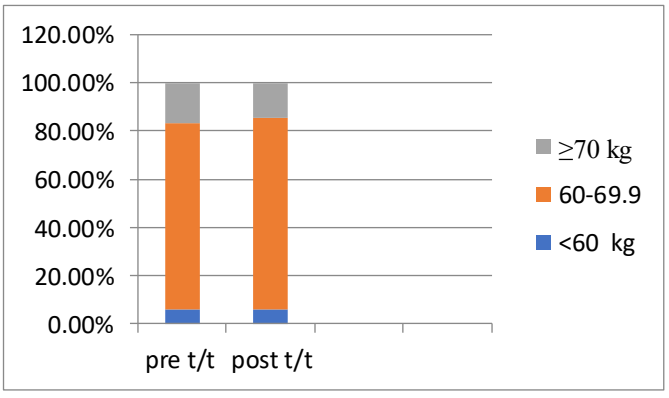

Fig. 4: Effect on weight before and after vitamin D supplementation.

Fig. 5 shows that 2 women (4.16%) had WHR <0.85 and 46 women (95.83%) had WHR>0.85 with a mean of 0.87±0.02 before treatment. Post-treatment, 4 women (8.33%) had WHR<0.85, and 44 women (91.66%) had WHR> 0.85, with a mean of 0.87±0.02. It was observed that there was no change in the mean WHR (from 0.87±0.02 to 0.87±0.02) with a paired t-test of 1.15 and p-value of 0.25.

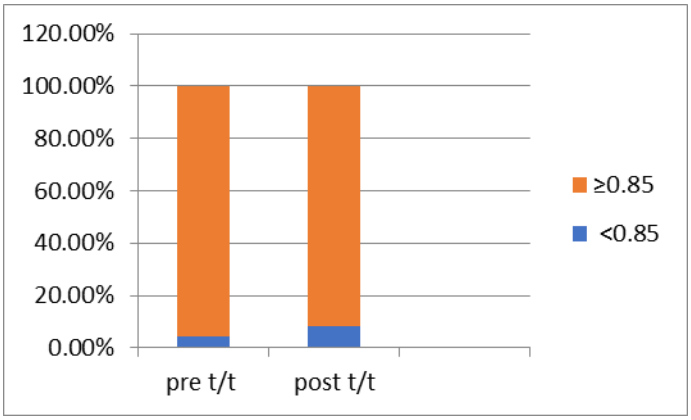

Fig. 5: Effect on waist-hip ratio before and after vitamin D supplementation.

DISCUSSION

The clinical characteristics of body weight, BMI, waist circumference, and WHR before and after treatment were studied. The results of our study corroborate the study of Zittermann *et al.* [11]. The impact of vitamin D on weight loss and cardiovascular disease risk factors in overweight people was investigated in their study. During 12 months, double-anonymized trials with a mean 25(OH) vitamin D concentration of 12 µg/ml were conducted on overweight subjects who received vitamin D (83 µg/day) or a placebo. The research findings indicated no adverse effect of daily vitamin D supplementation on weight loss in patients who were overweight or obese. The waist circumference significantly decreased in correlation with weight loss. Nevertheless, there was no discernible change (p<0.001). Our findings also corresponded with the Wamberg *et al.* [12] study. Their study was a double-blinded design involving 52 subjects aged 18–50 years with a BMI>30 kg/m^2 and plasma 25(OH) vitamin D <50 nmol/l. A placebo or 7000 I.U. of vitamin D per day was administered to the individuals randomly for 26 weeks. They discussed that vitamin D treatment did not change body fat compared to placebo.

However, contradictory results on waist circumference

were reported by Meena and Panda [13]. Researchers discovered that study patients had a substantially higher WHR (0.734±0.169) than controls (0.626±0.0932), indicating obesity is a key factor in PCOS and may have implications for metabolism and reproduction.

Low vitamin D levels may function as a risk factor, contribute to the pathophysiology of PCOS, or operate as a risk factor. Prior studies have connected vitamin D deficiency to PCOS. However, the results of our study observed an inverse relationship between vitamin D supplementation and clinical characteristics like BMI, weight, and WHR. Comparable outcomes were reported by Gokosmanoglu *et al.* [14], who found that the BMI and waist circumference of PCOS-affected women were negatively correlated with serum 25(OH) vitamin D concentrations. Additionally, Wehr *et al.* [15] did not observe any variation in waist-hip circumference following vitamin D supplementation. Similarly, Gupta *et al.* [16] discovered no difference in WHR and BMI in the study group supplemented with vitamin D. These outcomes concurred with the research we conducted.

CONCLUSIONS

This study concluded that administering vitamin D had no significant effect on the clinical parameters, i.e. weight, BMI, and WHR. The values of clinical parameters remained almost unchanged. However, vitamin D's lack of side effects implies its beneficial effects on this multifactorial polygenic disorder. Based on the results of our study, more investigation is probably required to find out how vitamin D might contribute to the development of PCOS. Large-scale randomized controlled trials are required to understand further the effects of vitamin D supplementation for women with PCOS.

CONTRIBUTION OF AUTHORS

Research concept- Dr. Shubha Pande
Research design- Dr. Shubha Pande
Supervision- Dr. Shubha Pande
Materials- Dr. Nida Khan
Data collection- Dr. Nida Khan
Data analysis and Interpretation- Dr. Nida Khan
Literature search- Dr. Nida Khan
Writing article- Dr. Nida Khan
Critical review- Dr. Nida Khan
Article editing- Dr. Nida Khan
Final approval- Dr. Shubha Pande

REFERENCES

[1] Diamanti-Kandarakis E, Kouli CR, Bergiele AT, Filandra FA, et al. A survey of the polycystic ovary syndrome in the Greek island of lesbos: Hormonal and metabolic profile. J Clin Endocrinol Metab., 1999; 84: 4006–11.

[2] Glueck CJ, Goldenberg N. Characteristics of obesity in polycystic ovary syndrome: Etiology, treatment, and genetics. Metabolism, 2019; 92: 108–20. doi: 10.1016/j.metabol.2018.11.002

[3] Holick MF. Vitamin D deficiency. N Engl J Med., 2007; 357: 266–81.

[4] Lim SS, Davies MJ, Norman RJ, Moran LJ. Overweight, obesity and central obesity in women with polycystic ovary syndrome: a systematic review and meta-analysis. Hum Reprod Update, 2012; 18(6): 618–37.

[5] Bakker K, Van-Houtum WH, Riley PC. The International Diabetes Federation focuses on the diabetic foot. Curr Diab Rep., 2005; 5(6): 436-40. doi: 10.1007/s11892-005-0051-y.

[6] Speroff L, Fritz M. Chronic Anovulation and The Polycystic Ovary Syndrome. Clin Gynecol Endocrinol Infertility, 2011; 8: 495–533.

[7] Faraji R, Sharami SH, Zahiri Z. Evaluation of Relation between Anthropometric Indices and Vitamin D Concentrations in Women with Polycystic Ovarian Syndrome. Journal of Family and Reproductive Health, 2014; 8: 123–29.

[8] Chauhan R, Sahani S, Garg A. Evaluation of vitamin D3 in patients of polycystic ovary syndrome and their correlation. Int J Reprod Contracept Obstet Gynecol., 2017; 6: 2010-16.

[9] 8.Yildizhan R, Kurdoglu M, Adali E, Kolusari A, Yildizhan B, et al. Serum 25-hydroxyvitamin D concentrations in obese and non-obese women with polycystic ovary syndrome. Arch Gynecol Obstet., 2009; 280: 559–63.

[10] Hahn S, Haselhorst U, Tan S, Quadbeck B, Schmidt M, et al. Low serum 25-hydroxyvitamin D concentrations are associated with insulin resistance and obesity in women with polycystic ovary syndrome. Exp Clin Endocrinol Diabetes, 2006; 114: 577–83.

[11] Zittermann A, Frisch S, Berthold H, Gotting C, Kuhn J, et al. Vitamin D Enhances the Beneficial Effects of Weight Loss on Cardiovascular Disease Risk Markers. The American J Clin Nutr., 2009; 89(5): 1321–27.

DOI: 10.21276/SSR-IIJLS.2024.10.1.37

[12]Wamberg L, Christiansen T, Paulsen S, Fisker S, Rask P, et al. Expression of vitamin D-metabolizing enzymes in human adipose tissue - the effect of obesity and diet-induced weight loss. Int J Obes., 2013; 37: 651–57. doi: 10.1038/ijo.2012.112.

[13]Meena M, Panda SR. Correlation of serum vitamin D level with various aspects of polycystic ovarian syndrome. Int J Reprod Contracept Obstet Gynecol., 2024; 13(2): 391–97p.

[14]Gokosmanoglu F, Onmez A, Ergenç H. The relationship between Vitamin D deficiency and polycystic ovary syndrome. Afr Health Sci., 2020; 20(4): 1880–86. doi: 10.4314/ahs.v20i4.45.

[15]Wehr E, Pieber TR, Obermayer-Pietsch B. Effect of vitamin D3 treatment on glucose metabolism and menstrual frequency in PCOS women—a pilot study. J Endocrinol Invest., 2011; 34: 757–63.

[16]Gupta T, Rawat M, Gupta N, Arora S. Study of Effect of Vitamin D Supplementation on the Clinical, Hormonal and Metabolic Profile of the PCOS Women. J Obstet Gynaecol India, 2017; 67(5): 349–55. doi: 10.1007/s13224-017-1008-1.