



Association of Serum Vitamin D Levels with Polycystic Ovary Syndrome in Reproductive-Age Women

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ABSTRACT

Polycystic ovary syndrome (PCOS) is a common endocrine disorder among reproductive-age women and is frequently associated with metabolic and hormonal abnormalities. Emerging evidence suggests that vitamin D deficiency may contribute to the pathophysiology of PCOS, but regional experimental data remain limited. The objective of this study was to evaluate the association between serum vitamin D levels and PCOS in reproductive-age women. This experimental case-control study was conducted on 120 women aged 18–35 years, including 60 diagnosed PCOS cases and 60 age-matched healthy controls. Serum 25-hydroxyvitamin D levels were measured using chemiluminescent immunoassay, while clinical and biochemical parameters were assessed using standardized protocols. Mean serum vitamin D levels were significantly lower in the PCOS group (14.8 ± 4.6 ng/mL) compared to controls (26.3 ± 6.1 ng/mL; $p < 0.001$). Vitamin D deficiency (<20 ng/mL) was observed in 78.3% of PCOS patients versus 31.7% of controls ($p < 0.001$). A significant inverse correlation was noted between vitamin D levels and body mass index ($r = -0.42$, $p = 0.002$) and serum testosterone ($r = -0.39$, $p = 0.004$) in PCOS patients. In conclusion, vitamin D deficiency is highly prevalent among women with PCOS and is significantly associated with adverse metabolic and hormonal profiles, suggesting its potential role as a modifiable risk factor in PCOS management.

Keywords: Polycystic ovary syndrome, Vitamin D deficiency, Reproductive-age women, Endocrine disorders

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INTRODUCTION

Polycystic ovary syndrome (PCOS) is one of the most prevalent endocrine disorders affecting women of reproductive age, with a global prevalence ranging from 6% to 20% depending on diagnostic criteria [1]. It is characterized by chronic anovulation, hyperandrogenism, and polycystic ovarian morphology, often accompanied by metabolic disturbances such as insulin resistance and obesity [2].

The etiology of PCOS is multifactorial and involves genetic, environmental, and lifestyle components. In recent years, micronutrient deficiencies have gained attention as potential contributors to the disorder's pathogenesis [3]. Among these, vitamin D has emerged as a key regulator of glucose metabolism, inflammatory pathways, and ovarian function [4].

Vitamin D receptors are expressed in ovarian tissue, pancreatic β -cells, and adipose tissue, suggesting a biological link between vitamin D status and PCOS-related abnormalities [5]. Deficiency of vitamin D has been associated with insulin resistance, menstrual irregularities, and hyperandrogenism, which are hallmark features of PCOS [6].

Despite growing international literature, data from South Asian populations remain scarce, and regional lifestyle, clothing practices, and sun exposure patterns may influence vitamin D status differently [7]. Furthermore, existing studies report inconsistent findings regarding the strength of association between vitamin D levels and PCOS severity.

Therefore, this experimental study was designed to investigate the association between serum vitamin D levels and PCOS in reproductive-age women, aiming to provide region-specific evidence and clarify the potential role of vitamin D deficiency in PCOS.

MATERIAL AND METHODS

Study Design and Setting

This experimental case-control study was conducted at Rafique Anwar Memorial Trust Hospital from January to June 2024.

Ethical Approval

The study was approved by the Institutional Ethical Review Committee under reference number ERC/PMC/2023/178-BIO, in accordance with the Declaration of Helsinki.

Sample

A total of 120 reproductive-age women (18–35 years) were enrolled. The sample included 60 women diagnosed with PCOS and 60 healthy age-matched controls.

Inclusion Criteria

Women diagnosed with PCOS based on Rotterdam criteria were included as cases. Controls were healthy women with regular menstrual cycles and no clinical or biochemical signs of hyperandrogenism.

Exclusion Criteria

Women with thyroid disorders, diabetes mellitus, hepatic or renal disease, pregnancy, lactation, or current vitamin D supplementation were excluded.

Biochemical Analysis

Fasting blood samples were collected for serum 25-hydroxyvitamin D estimation using chemiluminescent immunoassay. Serum testosterone, fasting glucose, and lipid profile were measured using automated analyzers.

Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were expressed as mean \pm SD. Independent t-test and chi-square test were applied where appropriate. Pearson correlation was used to assess associations. A p-value < 0.05 was considered statistically significant.

RESULTS

Table 1. Baseline Characteristics of Study Participants

Parameter	PCOS (n=60)	Controls (n=60)	p-value
Age (years)	26.4 \pm 4.1	25.9 \pm 3.8	0.52
BMI (kg/m ²)	28.7 \pm 3.9	23.6 \pm 2.8	<0.001

Women with PCOS had significantly higher BMI compared to controls.

Table 2. Serum Vitamin D Levels in Study Groups

Parameter	PCOS	Controls	p-value
Vitamin D (ng/mL)	14.8 \pm 4.6	26.3 \pm 6.1	<0.001
Vitamin D Deficiency (%)	78.3%	31.7%	<0.001

Serum vitamin D levels were markedly lower in PCOS patients, with a significantly higher prevalence of deficiency.

Table 3. Correlation of Vitamin D with Clinical Parameters in PCOS Group

Variable	Correlation (r)	p-value
BMI	-0.42	0.002
Serum Testosterone	-0.39	0.004

The results are presented across baseline characteristics, serum vitamin D levels, and their associations with clinical parameters.

A total of 120 women were included in the study, comprising 60 women diagnosed with polycystic ovary syndrome and 60 healthy controls. As shown in Table 1, there was no significant difference in mean age between the two groups. However, body mass index was significantly higher in women with polycystic ovary syndrome compared with controls, indicating a greater prevalence of overweight and obesity in the PCOS group.

Serum vitamin D levels differed markedly between the groups, as summarized in Table 2. Women with polycystic ovary syndrome had significantly lower mean vitamin D concentrations compared with controls. In addition, vitamin D deficiency was observed in more than three quarters of the PCOS group, whereas less than one third of the control group was deficient. Both differences were statistically significant, indicating a substantially higher burden of vitamin D deficiency among women with PCOS.

Correlation analysis within the PCOS group is shown in Table 3. Serum vitamin D levels demonstrated a significant inverse correlation with body mass index, indicating that lower vitamin D levels were associated with higher BMI. A similar inverse relationship was observed between vitamin D levels and serum testosterone concentrations. These findings suggest that reduced vitamin D status in women with PCOS is associated with increased adiposity and higher androgen levels.

Vitamin D levels showed a significant inverse correlation with BMI and serum testosterone.

DISCUSSION

The present study demonstrates a strong association between vitamin D deficiency and PCOS in reproductive-age women. Significantly lower serum vitamin D levels observed in PCOS patients align with earlier findings that highlight hypovitaminosis D as a common feature in PCOS [9].

The high prevalence of vitamin D deficiency in the PCOS group supports the hypothesis that vitamin D may influence ovarian steroidogenesis and metabolic homeostasis [10]. The observed inverse correlation between vitamin D levels and BMI is consistent with reports suggesting sequestration of vitamin D in adipose tissue [11].

Additionally, the negative association between vitamin D and serum testosterone reinforces the potential role of vitamin D in modulating androgen synthesis [12]. Previous interventional studies have shown improvement in menstrual regularity and androgen levels following vitamin D supplementation [13].

Compared to earlier studies, the novelty of this research lies in its experimental design and region-specific data generation, addressing a critical gap in South Asian populations [14]. The standardized biochemical assessment and strict inclusion criteria further enhance the reliability of findings.

However, the study is limited by its single-center design and lack of longitudinal follow-up. Future large-scale interventional studies are recommended to establish causality and therapeutic implications [15].

CONCLUSION

This study highlights a high prevalence of vitamin D deficiency among women with PCOS and demonstrates its significant association with obesity and hyperandrogenism. The findings underscore the novelty, sensitivity, and clinical relevance of vitamin D assessment as a rapid and accessible biomarker in PCOS evaluation and management.

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ETHICS STATEMENT

The study was conducted following approval from the Institutional Ethical Review Committee (ERC/PMC/2023/178-BIO).

COMPETING INTERESTS

The authors declare no competing interests.

FINANCIAL DISCLOSURE

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