

Vitamin D Status in Polycystic Ovary Syndrome Women of Rural Area of Bangladesh

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Abstract

Background: Polycystic Ovary Syndrome is the most common endocrine disorder and vitamin D deficiency is common in the general population as well as PCOS women in many parts of the world. Vitamin D deficiency is associated with calcium dysregulation, which contributes to the development of follicular arrest in women with PCOS and results in menstrual and fertility dysfunction.

Aim: This study aimed to determine the vitamin D status among women with polycystic ovary syndrome (PCOS) living in a rural area of Bangladesh and to compare it with age-matched non-PCOS controls.

Methods: A case-control study was conducted at a tertiary outpatient clinic in Kishoreganj, Bangladesh, from July 2023 to June 2025. A total of 202 women were enrolled, including 101 women with PCOS diagnosed and 101 age-matched controls. Anthropometric measurements were recorded, and serum 25-hydroxyvitamin D levels were measured by immunoassay. Vitamin D status was classified according to Endocrine Society guidelines. Data were analyzed using SPSS version 26, with $p < 0.05$ considered statistically significant.

Results: The mean age of study participants were 24.27 ± 6.49 years and 24.30 ± 6.54 in case and control groups respectively, with the mean BMI was 22 in cases and 20.5 in control group ($15-32 \text{ kg/m}^2$). Vitamin D status was found insufficient with the mean of $19.28 \pm 6.10 \text{ ng/ml}$ among PCOS women whereas the mean vitamin D status among control women was $27.45 \pm 5.87 \text{ ng/ml}$ which was significantly higher (< 0.001). Vitamin D deficiency was more profound in 21-30 years of age group (48.5%) and overweight PCOS women were found to be more deficient (48.5%) compared to control group. Earlier studies have indicated that lower vitamin D levels may be linked to greater metabolic disturbances in women with PCOS.

Conclusion: We found the evidence from this case control study that there is an association between low vitamin D level and PCOS. Therefore, further research with high quality randomized controlled trials is warranted to establish the impact of vitamin D deficiency in PCOS and its supplementation on the management of PCOS.

[Shaheed Syed Nazrul Islam Med Col J 2026, Jan; 11 (1):7-13]

DOI: <https://www.doi.org/10.69699/ssnimcj.2026.11.1.2>

Keywords: PCOS, 25 (OH) D.

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Introduction

Polycystic Ovary Syndrome (PCOS) is the most common endocrine disorder among women during reproductive years, with an estimated prevalence of 4-18% from puberty to menopause.^{1,2} It typically presents with menstrual irregularities, features of androgen excess, and/or characteristic polycystic changes in the ovaries.³ Metabolic disturbances are present in a majority of the women suffering from PCOS, i.e. 30–40% have impaired glucose tolerance and insulin resistance with compensatory hyperinsulinemia, and as many as 10% will develop type 2 diabetes mellitus during their fourth decade.⁴ Altered adipose tissue function has been recognized as a factor contributing to insulin resistance in women with PCOS. However, a substantial number of lean women affected by PCOS have insulin resistance as well, independent of obesity.^{2,5}

Vitamin D is a fat-soluble vitamin that is synthesized endogenously through sunlight-induced photochemical conversion of cholesterol to 7-dehydrocholesterol in the skin or obtained from the diet. Following its synthesis, vitamin D is metabolized through two hydroxylation steps. First, it is transported to the liver, where 25-hydroxylase converts it into 25-hydroxyvitamin D [25(OH)D]. The second hydroxylation occurs in the kidney and is catalyzed by 1 alpha-hydroxylase to form 1,25-dihydroxyvitamin D (1,25(OH)₂D), the active metabolite of vitamin D. Circulating 1,25(OH)₂D binds to vitamin D receptors (VDR) to initiate its effect. Serum 25(OH)D is the major circulating form of vitamin D and is used as the main indicator of vitamin D status.⁶

Vitamin D deficiency is common in the general population in many parts of the world, with 10-60% of adults having values lower than 20 ng/ml.⁷ Its deficiency disrupts the function of all the systems of the body and

increases the risk of chronic disease including physical diseases as malignancy, cardiovascular, autoimmune and infectious diseases and psychological disorders such as depression and chronic pain.⁸ There is accumulating evidence that vitamin D plays an important role in reproductive function. VDR (vitamin D receptors) have been found in the ovary, endometrium and placenta.⁹

Vitamin D deficiency has been suggested as a potential contributing factor linking insulin resistance with the pathophysiology of polycystic ovary syndrome (PCOS).¹⁰ A substantial proportion of women with PCOS are affected by inadequate vitamin D levels, with studies reporting that approximately two-thirds to more than four-fifths of PCOS patients have serum 25-hydroxyvitamin D [25(OH)D] concentrations below 20 ng/mL. Insufficient vitamin D status in PCOS has been associated with worsening clinical and metabolic features, including impaired insulin sensitivity, disturbances in ovulation and menstrual regularity, reduced fertility outcomes, increased androgen excess and hirsutism, higher body mass index, and elevated risk factors for cardiovascular disease.¹¹ Additionally, vitamin D deficiency may disrupt calcium homeostasis, which plays an important role in normal follicular development; such dysregulation can contribute to follicular arrest, menstrual abnormalities and subfertility in women with PCOS.¹² The high frequency of vitamin D deficiency observed in PCOS has also been linked to obesity, as vitamin D is fat soluble and tends to be sequestered in adipose tissue in obese individuals, leading to reduced circulating bioavailability.¹³ As the vitamin D status of Bangladeshi women with and without PCOS is not well documented, this study aims to assess vitamin D levels among PCOS patients in a rural population of Bangladesh.

Methods

This case–control study was conducted at the outpatient clinic of a rural health facility in Kishoreganj district, Bangladesh, from July 2023 to June 2025

A total of 202 women of reproductive age. The study population was divided into two groups: 101 women diagnosed with polycystic ovary syndrome (PCOS) (cases) and 101 age-matched women without PCOS (controls). PCOS was diagnosed according to the Rotterdam criteria, requiring the presence of at least two of the following features after exclusion of related disorders: oligo- or anovulation (oligomenorrhoea defined as a menstrual interval of 35–182 days or amenorrhoea defined as absence of menstruation for more than 182 days), clinical and/or biochemical hyperandrogenism, and polycystic ovarian morphology on ultrasonography.¹⁴ Controls were recruited from the same clinic and confirmed to have regular menstrual cycles, absence of hyperandrogenism, and no ultrasonographic evidence of polycystic ovaries using the same screening protocol. Detailed medical, reproductive and family histories were obtained, and anthropometric measurements

including height, weight and body mass index (BMI) were recorded; BMI was calculated as weight in kilograms divided by the square of height in meters and categorized as underweight (<18 kg/m²), normal (18.10–22.90 kg/m²), overweight (23–29.90 kg/m²) and obese (≥30 kg/m²). Venous blood samples were collected from all participants to measure serum 25-hydroxyvitamin D [25(OH)D] levels using an immunoassay method, and vitamin D status was classified according to Endocrine Society guidelines as deficient (<20 ng/mL), insufficient (21–29 ng/mL) or sufficient (≥30 ng/mL).¹⁵

Statistical Analysis

Statistical analysis was performed by statistical software (SPSS 26). Chi-square test for comparison of proportions were used. Statistical significance was determined by calculating the P values.

Results

A total of 101 PCOS patients and 101 controls were included in the analysis. Most of the women belongs to 21-30 years of age (50.5%) with the mean age of 24.27 ±6.49 years in case and 24.30 ±6.54 in control group (Table I).

Table I: Age distribution of the Study Participants

Age Range	PCOS		Controls	
	n	%	n	%
<20	28	27.7	27	26.7
21-30	51	50.5	52	51.5
>30	22	21.8	22	21.8
Total	101	100	101	100

Table II: Vitamin D level of the Study Participants

Vitamin D (ng/ml)	PCOS		Controls		p-value
	n	%	n	%	
<20	70	69.3	20	19.8	<0.001
21-30	19	18.8	49	48.5	
>30	12	11.9	32	31.7	
Total	101	100.0	101	100	

Mean vitamin D status among PCOS patient was 19.28±6.10 ng/ml, whereas the mean vitamin D status among control patient was 27.45±5.87 ng/ml which was significantly higher. About 18.8% of

PCOS women showed insufficient vitamin D level, 69.3% were deficient whereas only 11.9 % showed normal level of vitamin D. In comparison, 19.8% of control women showed deficient vitamin D level, 48.5% were insufficient and 31.7 % showed normal level of vitamin D. Vitamin D deficiency was more profound in 21-30 years of age group (48.5%).

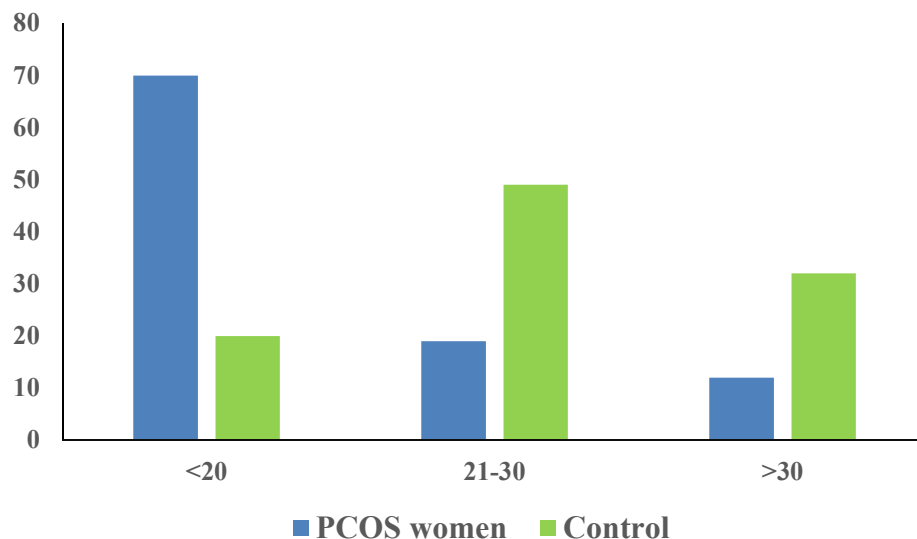


Figure 1. Vitamin D level of the study participants

Fig 1 describes Table I graphically where two important observation of this study becomes visible. First one is, prevalence of Vitamin D deficiency and insufficiency among (69.3% and 18.8%) PCOS women and secondly, Vitamin D insufficiency and sufficiency (48.5 % and 31.7%) among healthy control. Those differences among control group and PCOS women clearly showed Vitamin D deficiency is highly prevalent in Bangladeshi PCOS women.

Table III: BMI of the Study Participants

BMI (kg/m ²)	PCOS		Controls		p-value
	n	%	n	%	
<18 UNDER WEIGHT	9	8.9	19	18.8	<0.001
18.10-22.90 NORMAL	40	39.6	71	70.3	
23-29.90 OVER WEIGHT	49	48.5	11	10.9	
>30 OBESE	3	3	0	0	
Total	101	100.0	101	100	

Table III shows, among 101 PCOS women 8.9 % were of underweight, 39.6 % belongs to normal weight, 48.5 % were overweight and 3% were obese. Mean BMI of all women included was 22 (15-32 kg/m²), whereas mean BMI in control population was 20.5 which is significantly different ($p < .001$).

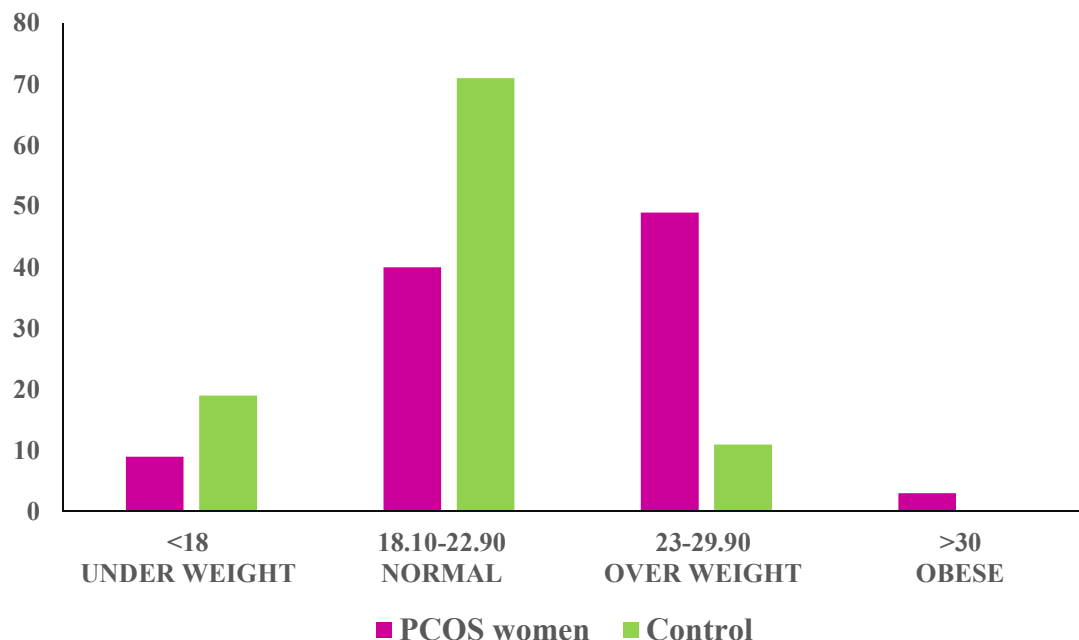


Figure 2. Age wise distribution of BMI among study participants

Fig 2 describes the distribution of BMI in case and control group according to different age groups. Overweight PCOS women were found to be more deficient (48.5%) in terms of Vitamin D compared to control group. In contrast, majority (70%) of the control population was found to be normal (18.10-22.90) in terms of BMI.

Table IV: BMI Vs Vitamin D level of the PCOS women (n=101)

BMI (kg/m ²)	Level Of Vitamin D (ng/ml)			Total
	<20 Deficient	21-29 insufficient	>30 Sufficient	
<18 Under weight	3	5	1	9
18.10-22.90 normal	29	4	1	40
23-29.90 Over weight	34	14	1	49
>30 Obese	3	0	0	3
Total	70	19	12	101

Table IV shows the level of Vitamin D among PCOS women (case) according to BMI categories. Vitamin D deficiency was highest (48.6%) in over weight PCOS women.

Discussion

Studies indicate that nearly two-thirds to four-fifths of women with PCOS exhibit vitamin D deficiency, with serum 25-hydroxyvitamin D concentrations falling below 20 ng/mL.¹¹ Another study from Bangladesh showed

vitamin D deficiency (68.33%) is highly prevalent in both PCOS as well as healthy women of reproductive age¹⁶. In our study it is 69.3% in 0 PCOS women. An earlier study showed significantly lower level of vitamin D (46.3±2) in overweight women compared to

women with a normal BMI.¹⁷ In our study vitamin D deficiency was more (48.6%) in over weight PCOS women compared to other BMI categories. Mean BMI of all PCOS women included was 22 (15-32 kg/m²) which was significantly higher compared to the control group (Mean BMI 20.5).

Vitamin D supplementation has been shown to reduce elevated serum AMH levels in vitamin D-deficient women with PCOS.¹⁸ Combined supplementation of vitamin D and calcium alongside metformin therapy has been associated with beneficial effects on menstrual cycle regulation and ovulation in women with PCOS.¹⁹ However, some studies demonstrated that there was no significant beneficial effect on insulin kinetics in PCOS women after supplementation of vitamin D.^{19,20}

Conclusion

This study demonstrates that vitamin D deficiency is highly prevalent among women with PCOS and may contribute to several characteristic manifestations of the syndrome, including insulin resistance, menstrual and ovulatory disturbances, infertility, hyperandrogenism, obesity, and an increased risk of cardiovascular complications. Although observational evidence consistently shows an inverse relationship between vitamin D status and metabolic dysfunction in PCOS, current data remain insufficient to establish a definitive causal link. The findings highlight the need for well-designed, high-quality randomized controlled trials to further clarify the role of vitamin D and to determine whether vitamin D supplementation can provide meaningful therapeutic benefits in the management of PCOS.

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