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ORIGINAL ARTICLE

Frequency of Vitamin D deficiency in women with polycystic ovarian syndrome

Islam Bano*[1], Sofia Naz[2], Ayesha Ismail[3], Tahira Yasmeen[4], Munazza Andaleeb[5]

[*1] Assistant Professor, Department of Obstetrics & Gynecology, Combined Military Hospital, Rawalpindi, Pakistan

[2] Senior Registrar, Department of Obstetrics & Gynecology, Combined Military Hospital, Quetta, Pakistan

[3] Medical Officer, Provincial Health Department, Combined Military Hospital, Khyber Pakhtunkhwa, Pakistan

[4] Post-Graduate Resident, Department of Obstetrics & Gynecology, Combined Military Hospital, Rawalpindi, Pakistan

[5] Senior Registrar, Department of Obstetrics & Gynecology, Combined Military Hospital, Quetta, Pakistan

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Correspondence

** Islam Bano*
drislambano@yahoo.com

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A B S T R A C T

Introduction: Approximately 20% of women who are of reproductive age suffer from the common endocrine illness known as polycystic ovarian syndrome, or PCOS. Vitamin D insufficiency is common among PCOS-affected women. The symptoms of PCOS seem to be regulated by the vitamin D pathway. According to studies, women with PCOS had high frequencies of vitamin D insufficiency, ranging from 65.0% to 70.3%. Thus, we aimed to discover how common vitamin D deficiency was in women diagnosed with PCOS.

Methodology: This cross-sectional study was conducted at the Department of Obstetrics & Gynecology, CMH- Rawalpindi, from January to July 2022. A total of 90 women with polycystic ovarian syndrome diagnosed on Rotterdam criteria, 18 to 40 years of age, were included through a non-probability consecutive sampling technique. Pregnant female patients with chronic illnesses were excluded. After informed consent, data was collected from patients on a self-developed questionnaire. In all patients, a 3 ml blood sample was taken and sent to the institutional pathology laboratory to measure vitamin D levels.

Results: The patients' average age was 28.91 ± 4.85 years—ages 18 to 30 comprised most of the 48 patients (53.33%). The average time a person had PCOS was 3.64 ± 1.58 years. The average body mass index was 29.02 ± 2.43 kg/m^2. Forty-one (45.56%) of the PCOS patients had vitamin D insufficiency.

Conclusion: As the frequency of vitamin D deficiency in women with PCOS is relatively high, we recommend that early identification through screening of the affected patients should be done.

Keywords: *Polycystic ovarian syndrome, Vitamin D deficiency, Insulin resistance, Metabolic syndrome.*

Introduction

Polycystic ovary syndrome (PCOS) is a prevalent endocrine system pathology that affects up to 20% of females in their reproductive age.[1] The exact prevalence is uncertain due to the lack of precise definition, but it is estimated to be 5-10% among women of reproductive age. The new Rotterdam criteria suggest that the prevalence in the general female population will increase to 10%.[2] Globally, PCOS affects approximately 2.2 to 26% of women, with roughly 1 in 15 women being affected. In India, the prevalence is exceptionally high, with 36% of women suffering from PCOS.[3] PCOS is a leading cause of female infertility and is characterized by symptoms such as anovulation-oligomenorrhea, amenorrhea, polycystic ovaries on ultrasound, excess androgenic hormones (leading to hirsutism, acne, alopecia, and seborrhea), and insulin resistance.[4]

Women with PCOS are also more prone to mental disorders such as anxiety, depression, binge eating disorder and even bipolar disorder.[5] PCOS is associated with excessive androgen secretion, which leads to increased estrogen production and disrupts folliculogenesis.[6] Hyperandrogenism and insulin resistance contribute to chronic anovulation and infertility in PCOS patients.[7] The body's resistance to insulin plays a critical role in the pathogenesis of PCOS, even in lean women. It is a key feature and predisposes patients to type II diabetes in the long run. While many PCOS patients are overweight or obese, some may have an average or lower body mass index (BMI). Identifying and screening PCOS patients for pre-diabetes and diabetes is crucial for counseling and implementing lifestyle modifications to delay or reduce the severity of diabetes mellitus.[8] Deficiency of vitamin D is prevalent in women with PCOS and is related to co-morbidities related to the syndrome. Hormonal abnormalities triggered by irregularities in steroidogenesis contribute to the clinical presentation of PCOS.[9] The vitamin D pathway is proposed to have a regulatory role in the endocrine symptoms of PCOS symptoms, leading to infertility and metabolic imbalance.[6]

According to studies, women with PCOS have a significantly high occurrence of vitamin D insufficiency, ranging from 65.0% to 70.3%.[8] To effectively diagnose and treat PCOS, one must comprehend its pathogenesis, including insulin resistance and vitamin D deficiency.2, 9 More studies are required to create tailored therapies for PCOS patients and investigate the processes behind these relationships. Our study aims to assess the prevalence of vitamin D deficiency in women diagnosed with PCOS. Despite existing research, there is a lack of local data, which limits the development of effective treatment strategies and modifications. The results will establish the local magnitude of the problem and enable clinicians to make practical recommendations for early diagnosis and management of PCOS, thereby improving fertility outcomes for affected women.

Methodology

We conducted this cross-sectional study at the Obstetrics & Gynecology Department of Combined Military Hospital- Rawalpindi. The study spanned from January 25, 2022, to July 24, 2022. Using the WHO calculator for single population proportion, the following assumptions were taken to calculate the sample size, confidence level (95%), margin of error (10%) and frequency of vitamin D deficiency in women with PCOS (65.0%). A sample size of 88 was calculated.[8] A non-probability consecutive sampling technique was employed to recruit a sample of 90 women who were diagnosed with PCOS and were between the age range of 18 to 40 years.

Inclusion criteria: The study included PCOS patients who met the Rotterdam criteria for PCOS diagnosis. According to the Rotterdam criteria, two of the following three symptoms must be present for PCOS to be diagnosed: Polycystic ovaries on ultrasonography, ovulation failure, and hyperandrogenism or hyperandrogenemia.[10]

Exclusion criteria: Pregnant women and individuals with chronic renal or liver disease, acid peptic disease, or a medical history of diabetes mellitus or hypertension.

Approval was obtained from the ethical committee of CMH Rawalpindi (ERC: 465- 12/09/2021), and informed consent was acquired from each participant. Data collection involved recording various demographic variables, including age, BMI, and duration of PCOS. In all patients, a 3 ml blood sample was taken and sent to the institutional pathology laboratory to measure vitamin D levels. Additional information was gathered regarding participants' place of residence (rural/urban), occupation (fieldwork/office work/domestic), sun exposure (frequency and duration), and the presence or absence of vitamin D deficiency. Vitamin D deficiency was determined based on the serum levels of vitamin D, with values below 20 ng/ml indicating a lack. The categorization of sun exposure levels is as follows: low exposure refers to sunlight exposure less than 3 times a week for less than 15 minutes per day over the past 3 months, medium exposure corresponds to sunlight exposure 3-4 times a week for 15-30 minutes at a time, and high exposure indicates sunlight exposure exceeding 5 times a week for more than 30 minutes at a time within the past 3 months. A pre-designed Performa was utilized to ensure accurate and consistent data collection.

SPSS V 25.0 was employed to conduct the statistical analysis. Mean and standard deviation (SD) were computed for age and BMI. Frequencies and percentages

were used to represent the length of PCOS, place of residence, occupation, and sun exposure. To investigate the possible impact of several factors on vitamin D deficiency, stratified controls were used to effect modifiers such as age, BMI, length of PCOS, place of residence, occupation, and sun exposure. The relationship between these variables and the existence of vitamin D insufficiency was examined using the post-stratification chi-square test. If the p-value was less than 0.05, it was deemed statistically significant.

Results

Table 1 and 2 shows the features of our patients, both clinical and sociodemographic. The mean ± SD of age and BMI of the patients in our study were 28.9 ± 4.85 years and 29.02 ± 2.43 kg/m^2, respectively. Most patients were in the age group of 18-30 years 48 (53.3%), lived in urban areas 50 (55.6%), did not have vitamin D deficiency 49 (54.4%), and had PCOS for more than 3 years 68 (75.6%), had low sun exposure 41 (45.6%) and were involved in domestic chores 45 (50.0%).

Table 3 summarizes the Mean and SD of age and BMI in patients with PCOS, stratified by vitamin D deficiency. No statistically significant difference was found in the mean age (P = 0.333) or mean BMI (P = 0.550) between patients with and without vitamin D deficiency.

Table 4 shows the cross-tabulation between vitamin D deficiency statuses with the categorical variables with Chi-square test p values applied to see any significant difference in the categories of the variables concerning vitamin D status. No statistically significant difference was found between the duration of PCOS (P = 0.616), BMI (P = 0.180), residence (P = 0.170), sun exposure (P = 0.185), or occupation (P = 0.154) in the vitamin D deficient and non-deficient PCOS patients.

Table 1: Age and BMI

Parameters	Mean ± SD	Range
Age in years	28.91 ± 4.85	22-37
BMI in g/m^2	29.02 ± 2.43	24-35

Table 2: Clinical and Sociodemographic Features of the Patients

Parameters	No. of Patients (n=90)	Percentage
Age (years)		
18-30	48	53.33
31-40	42	46.67
Residence		
Rural	40	44.44
Urban	50	55.66
Vitamin D deficiency		
Present	41	45.55
Absent	49	54.55
Duration of PCOS		
≤ 3 Years	22	24.55
>3 Years	68	75.55
Sun Exposure		
Low	27	30.00
Medium	41	45.55
High	22	24.55
Occupation		
Office work	19	21.11
Fieldwork	26	28.99
Domestic work	45	50.00

Table 3: Segregation of Vitamin D status of patients with age and BMI of patients

Parameters	Vitamin D deficiency		T-test (p-value)
	Present Mean ± SD. (n=41)	Absent Mean ± SD. (n=49)	
Age (Years)	28.37 ±4.78	29.37 ± 4.92	P = 0. 333
BMI (kg/m^2)	28.85 ± 2.24	29.16 ± 2.59s	P = 0. 550

Table 4: Segregation of Vitamin D status of patients with categorical variables

Parameters	Vitamin D deficiency		Chi-Square Test p-value
	Present (n=41)	Absent (n=49)	
Duration (years)			
≤ 3	9 (21.95%)	13 (26.53%)	0.616
> 3	32 (78.05%)	36 (73.67%)	

BMI (kg/m2)			
≤ 25	06 (14.63%)	03 (06.12%)	0.180
> 25	35 (85.37%)	46 (93.88%)	
Residence			
Rural	15 (37.59%)	25 (51.02%)	0.170
Urban	26 (63.41%)	24 (48.98%)	
Sun Exposure			
Low	16 (39.02%)	11 (22.45%)	
Medium	15 (36.58%)	26 (53.41%)	0.185
High	10 (24.40%)	12 (24.49%)	
Occupation			
Office work	10 (24.40%)	09 (18.37%)	
Fieldwork	15 (36.58%)	11 (22.45%)	0.154
Domestic work	16 (39.02%)	29 (59.18%)	

Discussion

Among women who are undergoing anovulation, PCOS is a common cause of ovarian dysfunction. Numerous genetic and environmental factors interact to impact a spectrum of gonadotropic and metabolic abnormalities, which are closely linked to the phenotypic expression of this condition.[1] Between 67 and 85% of women with PCOS had blood concentrations of 25 (OH) D less than 20 ng/ml, which indicates vitamin D insufficiency.[3] Insufficient levels of 25-hydroxyvitamin D [25(OH)D] have been found to potentially amplify the manifestations of PCOS, encompassing insulin resistance, disturbances in ovulation and menstruation, infertility, excessive androgen production, obesity, and increased susceptibility to cardiovascular ailments.[3, 9]

The age range of the studied patients was 22 to 37 years, with a mean age of 28.91 ± 4.85 years. Patients between 18 to 30 years of age were in the majority 48 (53.33%). A higher proportion of patients had vitamin D deficiency 41 (45.56%), a known risk factor for PCOS. Most patients had low sun exposure, which is another known risk factor for vitamin D deficiency and indirectly as well as directly for the development of PCOS. Most patients worked in office jobs, which may be a contributing factor to their low sun exposure. Our results align with the literature indicating the association of PCOS with lower vitamin D levels and altered hormonal profiles.

In Peshawar, a study assessing the vitamin D status of patients with PCOS found that only 19 (17.76%) patients with PCOS had vitamin D levels above 30 ng/ml, whereas 70 (65.42%) patients had vitamin D deficiency and 18 (16.82%) patients had vitamin D insufficiency.[11] According to an Indian study, women with PCOS had significantly lower serum 25 (OH) D concentrations than the control group (11.91 ± 10.57 vs 21.09 ± 18.07 ng/mL, P = 0.001). Additionally, compared to the control group, PCOS patients had a considerably greater frequency of vitamin D deficiency (61.84 vs. 38.16%, P < 0.0001).[12] A study from Iraq concluded that patients with PCOS exhibited a significantly lower vitamin D level than the healthy subjects' group (14.16 vs. 17.83 ng/ml; P = 0.010).[13]

After controlling for confounding variables, a relationship between increased vitamin D levels and PCOS was established in an investigation. The study did not, however, find any clear advantages of these increased vitamin D levels on metabolic disruption. This implies that while a correlation between elevated vitamin D levels and PCOS was noted, there was insufficient evidence in the study to substantiate a direct amelioration of metabolic dysfunction.[14] To determine if vitamin D deficiency and PCOS development are related, Kim et al. found that vitamin D deficiency was as common in patients as in controls.[15] Consequently, there is inconsistent research in the literature about the similarity of vitamin D levels between women with PCOS and those without the condition. The mean BMI of our patients was 29.02 ± 2.43 kg/m^2, which is within the range of overweight and obese. The range of BMIs in the study population was 24 to 35 kg/m^2, which suggests that the disease can affect women of all body sizes, but the majority of them are obese or overweight. There was no significant difference in mean age and BMI between our patients with and without vitamin D deficiency. This suggests that vitamin D deficiency is not affected by either age or BMI of the patients with PCOS.

Numerous scholars have comprehensively examined the correlation between adiposity, as measured by BMI, and vitamin D levels in women afflicted with PCOS. The BMI, while possessing certain limitations in terms of accuracy, remains widely employed as a means of assessing adiposity status across various populations. Numerous scholars have documented a negative correlation between BMI and levels of vitamin D. A study from Egypt reported that although Vitamin D level was significantly reduced in women with PCOS compared to healthy women, no remarkable changes in Vitamin D levels

were related to age group and BMI.[16]Kensara's study, after accounting for age and BMI as confounding variables, revealed a notable decrease in vitamin D levels among slender women afflicted with untreated PCOS compared to the control group.[17] Henceforth, in light of our investigations and the comprehensive examination of evidence, it can be posited that the diminishment of vitamin D in PCOS is not subject to direct influence by BMI. Nevertheless, it is plausible that BMI may influence the array of metabolic disruptions intricately linked to this malady.

Because 1 alpha-hydroxylase and vitamin D receptors (VDRs) are found in various tissues, previous research has linked vitamin D deficiency to infertility. The ovaries, uterus, and placenta are among the female reproductive organs where VDRs have been specifically found. Moreover, studies have shown that females with null vitamin D receptors may have poor folliculogenesis and infertility.[18] This data adds credence to the notion that vitamin D is essential for reproductive health and raises the possibility of a connection between problems with conception and vitamin D insufficiency.

Numerous scholarly investigations have delved into the correlation existing between the status of vitamin D and the hormonal or metabolic characteristics observed in patients afflicted with PCOS. In the context of individuals diagnosed with PCOS, it is postulated that a diminished concentration of vitamin D may be intricately linked to a plethora of metabolic risk factors. These include insulin resistance, elevated total cholesterol levels, hypertension, glucose deregulation, heightened C-reactive protein levels, augmented triglyceride levels, and diminished high-density lipoprotein (HDL) cholesterol concentration.[2, 3, 19] Meta-analyses of the randomized controlled trials have demonstrated that vitamin D administration can enhance specific metabolic parameters in PCOS patients.[3, 20] First, it was discovered that using vitamin D supplements significantly raised total testosterone levels in PCOS patients, indicating a favorable effect on hormonal balance (weighted mean difference [WMD] = -0.10, 95% CI [-0.18, -0.02]).[3] The homeostasis model assessment (HOMA-IR) score, which measures insulin resistance, also showed benefits with vitamin D administration, suggesting improved insulin sensitivity (WMD = -0.44, 95% CI [-0.86, -0.03]).[3] Additionally, vitamin D supplementation improved β-cell activity as determined by the HOMA-β index, indicating a beneficial effect on pancreatic β-cell function (WMD = -16.65, 95% CI [-19.49, -13.80]).[3]

A placebo-controlled, double-blind research that gave 50,000 IU of vitamin D every two weeks to the intervention group for eight weeks documented the positive effects of vitamin D supplementation on the lipid profile and insulin metabolism of PCOS-affected infertile women.[2] The findings above prove that vitamin D administration may be beneficial in treating metabolic deregulation in PCOS patients. Regarding the relationship between vitamin D intake and the reduction of PCOS symptoms, a 2021 review on the topic came to the unclear and non-determinative conclusion that there is insufficient data.

The studies they examined did not produce substantial evidence or definitive results supporting a connection between vitamin D intake and the reduction of PCOS symptoms.[19, 20] The different results in this study about the relationship between vitamin D deficiency and PCOS compared to other populations could be explained by the different degrees of gonadotrophic and metabolic abnormalities that are impacted by multiple genetic and environmental factors interacting.

Conclusion

As the frequency of vitamin D deficiency in women with PCOS is relatively high, we recommend that early identification through screening of the affected patients should be made for proper lifestyle changes or Pharmacological treatment to reduce associated morbidity.

Limitations

The data was collected from a single healthcare facility. This may limit the generalizability of the results.

Recommendations

Vitamin D's role in the pathogenesis and management of PCOS on a larger scale through clinical trials should be explored.

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References

1. Agrawal A, Kapse A, Chaudhary A, Kalambe M. Polycystic ovarian syndrome: An overview. Australas Med J. 2021; 14(12). DOI: 10.3390/life12121974
2. Dastorani M, Aghadavod E, Mirhosseini N, Foroozanfard F, ZadehModarres S, AmiriSiavashani M, Asemi, et al. The effects of vitamin D supplementation on metabolic profiles and gene expression of insulin and lipid metabolism in infertile polycystic ovary syndrome candidates for in vitro fertilization. ReprodBiolEndocrinol. 2018; 16:1-7. DOI: https://doi.org/10.1186/s12958-018-0413-3
3. Miao CY, Fang XJ, Chen Y, Zhang Q. Effect of vitamin D supplementation on PCOS: a meta-analysis. ExperTherap Med. 2020; 19:2641-49. DOI: https://doi.org/10.3892/etm.2020.8525
4. Jameel R, Kamran A, Jaffri SA, Sultan S. Frequency of vitamin d deficiency in women with polycystic ovarian syndrome. J SocObstetGynaecol Pak. 2019; 9(3):153-7.
5. Omran EF, Ramzy A, Shohaye A, Farouk N, Soliman M, Baz H, et al. Relation of serum vitamin D level in polycystic ovarian syndrome (PCOS) patients to ICSI outcome. Middle East Fertility Society J. 2020; 25:22. DOI: https://doi.org/10.1186/s43043-020-00034-3
6. Muscogiuri G, Altieri B, de Angelis C, Palomba S, Pivonello R, Colao A, et al. Shedding new light on female fertility: the role of vitamin D. Rev EndocrMetabDisord. 2017; 18:273-83. DOI: https://doi.org/10.1007/s11154-017-9407-2
7. Khalifa OM, ELgarhy ET, Alomda FA, Yehia MB. Assessment of serum vitamin D level in women with PCOS. Al-Azhar Int Med J. 2021; 2(11):43-8. DOI: https://doi.org/10.21608/aimj.2021.96806.1582
8. Hanif QA, Qamar S, Aslam P, Omar H, Mustafa N, Masood S. Association of vitamin D deficiency with polycystic ovarian syndrome. Pak Armed Forces Med J. 2019; 69(2):241-44.
9. Gracelyn LJ, Pushpagiri N. Prevalence of glucose tolerance test abnormalities in women with polycystic ovarian syndrome. Int J ReprodContraceptObstet Gynecol. 2017;4(6):1740. DOI: https://doi.org/10.18203/2320-1770.ijrcog20151215
10. Wang R, Mol BW. The Rotterdam criteria for polycystic ovary syndrome: evidence-based criteria?. Hum Reprod. 2017; 32(2):261-4. DOI: https://doi.org/10.1093/humrep/dew287
11. Fareed A, Nauman D, Naeem A. Determine the Frequency of Vitamin D Deficiency in Patients with Polycystic Ovarian Syndrome. Pak J Med Health Sci. 2020; 25(24):22-43.
12. Gupta V, Mathur P, Jauhari R. Correlation of Vitamin D Levels with PCOS: A Cross-sectional Study. J Pharm Res Int. 2021; 17:41-7. DOI: https://doi.org/10.9734/JPRI/2021/v33i59B34350
13. Israel N, Shamdeen M. The relation between PCOS and Vitamin D deficiency. Med J Babylon. 2019; 16(3):234. DOI: https://doi.org/10.4103/MJBL.MJBL_37_19
14. Lumme J, Sebert S, Pesonen P, Piltonen T, Järvelin MR, Herzig KH, et al. Vitamin D levels in women with PCOS: a population-based study. Nutrients. 2019; 11(11):2831. DOI: https://doi.org/10.3390/nu11112831
15. Asimi VZ. Evaluation of the association of vitamin D deficiency with gonadotrophins and sex hormones in obese and non-obese women with PCOS. Med Glas (Zerica) 2014; 11(1):170-6.
16. Hamdi RA, Abdul-Qahar ZH, Kadhum EJ, Alsaeed FA. Assessment of Serum Vitamin D Levels in Women with PCOS. Journal of the Faculty of Medicine Baghdad. 2018; 60(2):93-7.
17. Kensara OA. Prevalence of hypovitaminosis D and its association with hypoadiponectinemia and hyperfollistatinemia, in Saudi women with naïve PCOS. J ClinTranslEndocrinol. 2018; 12:20-5. DOI: https://doi.org/10.1016/j.jcte.2018.04.001
18. Joham AE, Teede HJ, Cassar S, Stepto NK, Strauss BJ, Harrison CL, et al. Vitamin D in polycystic ovary syndrome: Relationship to obesity and insulin resistance. Molecular nutrition & food research. 2016; 60(1):110-8. DOI: https://doi.org/10.1002/mnfr.201500259
19. Sulaiman EA, Dhiaa S, Merkhan MM. Overview of vitamin D role in polycystic ovarian syndrome. MMSL. 2022; 91(1):37-43. DOI: https://doi.org/10.31482/mmsl.2021.027
20. Williams A, Babu JR, Wadsworth DD, Burnett D, Geetha T. The effects of vitamin D on metabolic profiles in women with PCOS: a systematic review. Hormone and Metabolic Research. 2020; 52(07):485-91. DOI: https://doi.org/10.1055/a-1160-9902