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Original Research Article

A Case Control Study of Investigating the Relationship between Vitamin D Level and Polycystic Ovarian Syndrome

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Abstract:

Background: Patients with polycystic ovarian syndrome (PCOS) typically experience vitamin D insufficiency, which has been demonstrated to have a variety of negative impacts on the illness process. The purpose of this study is to compare vitamin D levels in the PCOS and control groups. Aim to examine the relationship between PCOS women's serum 25(OH)D levels and metabolic risk factors.

Methods: 49 women with PCOS were selected as cases, while 49 individuals without the condition served as controls. Age, BMI, menstrual cycle, and clinical traits including hirsuitism and acne were documented for the patients and controls, respectively. Measurements were made of the metabolic indicators and serum 25(OH)D. The primary result was the variation in vitamin D status between cases and controls, and the secondary results were correlations between serum 25(OH)D levels and metabolic risk variables in PCOS-affected women.

Results: When compared to controls, patients had significantly reduced vitamin D levels ($P < 0.05$). In cases, there was a substantially higher prevalence of IR in the Vitamin D insufficiency group ($P < 0.05$), but not for BMI or fasting insulin. Additionally, the frequency of obesity and an abnormal lipid profile was not noticeably higher in the PCOS patients with vitamin D deficiency.

Conclusion: Vitamin D deficiency is common, especially in PCOS women with IR and metabolic risk factors like HDL-C. For PCOS women, larger sample sizes are required to investigate the association with other metabolic risk factors.

Keywords: PCOS; Serum Vitamin D levels, Testosterone, Insulin.

Introduction

An endocrine disorder called polycystic ovary syndrome (PCOS) is frequently observed in women of reproductive age. Polycystic ovarian morphology, hyperandrogenism, and ovulatory dysfunction are traits of PCOS. [1]

PCOS's cause is yet unknown. Evidence, however, points to a multifactorial basis, with expression evident in women with a genetic predisposition. [2] Insulin resistance is the primary finding in the pathophysiology of PCOS. [3]

Strong links exist between this developing in conjunction with weight gain, an increase in waist circumference, and ovarian dysfunction. [4] Hyperandrogenemia is aggravated by obesity and insulin resistance. [5]

In women with PCOS, increased adipose tissue and hypernadrtogenemia are associated with an increased risk of cardiovascular disease, type 2 diabetes mellitus, hypertension, endometrial cancer, and inflammation-related disorders. [6,7,8] Several long-term medical disorders include obesity, cardiovascular disease, type 2 diabetes, cancer, autoimmune, infectious disease, and psychological disturbance are all made more likely by vitamin D insufficiency. [9] A known risk factor for vitamin D deficiency is obesity. [10] In earlier studies, women with PCOS showed a negative connection between body mass index and serum 25(OH)D3 concentrations [11].

In addition to skeletal muscle, various other tissues also express the vitamin D receptor (VDR). Thus, in addition to the well-known calcium-bone metabolism, the cardiovascular system, cancers, and female reproductive tissues such the ovaries, placenta, endometrium, and fallopian tubes, it is linked to glucose metabolism. [12]

Material and Methods

This case - control study was conducted at Department of Obstetrics and Gynaecology, Darbhanga Medical College and Hospital, Laheriasarai, Bihar from July 2021 to June 2023. 49 women with PCOS in all were selected from our

obstetrics and Gynecology department at DMCH. As controls, 49 age-matched females without PCOS were selected. The PCOS diagnosis was made using the revised Rotterdam criteria. [13] Women who had hyperprolactinemia and hypothyroidism were not included.

Age, body mass index (BMI), and blood pressure were among the fundamental details gathered through a questionnaire. Obesity was classified as having a BMI >/= 28.0 kg/m^2. [14]

All biochemical markers, such as serum 25(OH)D, follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin (PRL), testosterone (T), fasting blood glucose, fasting insulin, and lipid profile, were examined in our hospital. In order to assess insulin resistance (IR), HOMA-IR was determined.

HOMAIR = [fasting glucose (mmol/L) × fasting insulin(mIU/L)]/ 22.5. HOMA-IR > 2.5 was defined as IR.15 Serum vitamin D levels <20 ng/mL, 20 - 30 ng/mL and >/= 30 ng/mL were defined as deficiency, insufficiency and normal respectively. [16]

The difference in vitamin D levels between the PCOS and control groups was the main finding. The relationship between PCOS women's serum vitamin D levels and metabolic risk variables was the secondary endpoint. Utilizing SPSS (version 27.0), data was examined. For numerical variables, the data had been summarized using the mean and standard deviation, and for categorical variables, count and percentages. Independent samples or unpaired samples were used in two-sample t-tests to see if the means were different. For numerical data, one-way analysis of variance (one-way ANOVA) was used to compare the means of three or more samples.

Results

Age, BMI, SBP, DBP, and PRL differences were discovered to be statistically significant (p value<0.05). In the remaining measures, there were no statistically significant differences between the two groups.

In comparison to controls, PCOS women had significantly lower serum 25(OH)D concentrations (19.3967±11.4876 vs. 28.8120±10.7247, p<0.0001) (Table 1).

Additionally, women with PCOS had considerably higher prevalence rates of 25(OH)D insufficiency and deficit than did controls (65.3% vs. 18.4%, P <0.01; 26.5%)% vs. 22.4%, P <0.0001). Furthermore, compared to controls, women with PCOS had a considerably lower prevalence of normal 25(OH)D status (8.2% vs. 59.2%, P <0.01).

Table 1: Comparing baseline characteristics of case and control groups

Characteristics	Case (n=49)	Control (n=49)	p-value
Age	23.78±5.67	27.45±5.45	0.001
BMI	25.35±5.44	23.11±2.81	0.013
Systolic Blood Pressure (SBP)	113.67±10.74	127.35±6.38	0.000
Diastolic Blood Pressure (DBP)	73.59±8.30	69.84±8.61	0.030
LH/FSH	2.61±4.91	2.80±4.89	0.846
Testosterone	22.98±22.37	28.31±21.92	0.236
PRL	15.24±5.18	15.05±5.04	0.854
Vitamin D Level	19.40±11.49	28.81±10.73	0.0001
Fast Insulin	11.63±16.01	13.47±19.30	0.609

Table 2 compares the metabolic variables (BMI, Fasting Insulin, and IR) between the three categories of PCOS patients with deficiencies, insufficiencies, and normal Vit. D levels. Statistics were only found to be significant for the difference in IR. (P value <0.05).

Table 2: Comparing metabolic factors with vitamin D deficiency, insufficiency and normal sub-groups among PCOS women

Metabolic Factor	Deficiency (n=32)	Insufficiency (n=13)	Normal (n=4)	p-value
BMI	25.72±5.07	24.91±6.10	23.77±7.37	0.760
Fast Insulin	13.70±19.50	7.93±2.90	7.06±2.25	0.469
Insulin Resistance	4.09±3.80	1.42±0.42	1.52±0.49	0.026

Table 3 shows the frequency of obesity, aberrant lipid profiles, and HOMA-IR in PCOS-affected women across various vitamin D categories. Between the three groups, there was a statistically significant difference in HOMA-IR (P< 0.05). When comparing the prevalence of obesity and abnormal lipid profiles amongst various groups, there was no discernible difference (P > 0.05).

Table 3: Comparing prevalence of obesity, lipid derangement and Insulin resistance between deficiency, Insufficiency and normal Vitamin D sub-groups of the cases

Metabolic Factor	Deficiency (n=32)	Insufficiency (n=13)	Normal (n=4)	p-value
Obese (BMI>28kg/m^2)	18(66.67%)	7(25.93%)	2(0.54%)	
Non-obese (BMI<28kg/m^2)	14(63.6%)	6(27.27%)	2(9.1%)	0.967
Lipid profile deranged	21(75.0%)	6(21.43%)	1(4.55%)	
Lipid profile normal	11(52.38%)	7(33.33%)	3(14.28%)	0.195
Insulin resistance present	26(100.0%)	0(0.0%)	0(0.0%)	
Insulin resistance absent	6(26.1%)	13(56.5%)	4(17.4%)	0.000

According to Table 4, there was a vitamin D insufficiency in 62.5% of PCOS women with hypercholesterolemia, 50% with increased HDL cholesterol, 85.7% with increased LDL cholesterol, 100% with increased VLDL cholesterol, and 75% with increased triglycerides. Additionally, none of those PCOS women with normal vitamin D levels showed any lipid abnormalities, with the exception of one person who had elevated HDL.

Table 4: Shows the percentage of cases with a specific lipid derangement within different categories of Vitamin D level in PCOS patients

Lipid derangement type (n=22)	Deficiency (n=32)	Insufficiency (n=13)	Normal (n=4)	P-value
Cholesterol (n=8)	5(62.5%)	3(37.5%)	0(0.0%)	0.191
HDL (n=2)	1(50.0%)	0(0.0%)	1(50.0%)	0.028
LDL (n=7)	6(85.7%)	1(14.28%)	0(0.0%)	0.160
VLDL (n=1)	1(100.0%)	0(0.0%)	0(0.0%)	0.221
Triglyceride (n=4)	3(75.0%)	1(25.0%)	0(0.0%)	0.241

Discussion

Vitamin D insufficiency affects more than a billion people worldwide, both adults and children. [17] Comparatively to non-PCOS women, PCOS women have a greater prevalence of vitamin D deficiency, and this deficit is linked to ovulatory dysfunction, IR, and hyperandrogenism [18].

In addition, the prevalence rates of 25(OH)D deficit and insufficiency were much higher in women with PCOS than in controls, which is similar to a prior study, and our analysis revealed significantly lower vitamin D levels among patients. [19] Numerous observational studies have demonstrated that in women with PCOS, decreased vitamin D concentration is linked to elevated BMI, IR, testosterone, and dehydroepiandrosterone sulphate (DHEAS) levels [22]. In our investigation, it was discovered that PCOS women with IR had considerably lower serum 25(OH)D concentrations than PCOS women without IR. Additionally, compared to women without IR, PCOS women with IR had a considerably greater frequency of 25(OH)D insufficiency. Epidemiological research has demonstrated a negative correlation between vitamin D level and diabetes, which may have multiple contributing factors.

Research has shown that 25(OH)D promotes insulin receptor expression and decreases the production of inflammatory cytokines, both of which are known to produce IRS. [20] Studies have shown that vitamin D regulates extracellular calcium, which in turn enhances the activity of insulin. [21] Ng et al. and other researchers, however, have shown that among PCOS women, there was no statistically significant association between vitamin D level and BMI, WHR, or metabolic parameters. [12]

In our investigation, the group of cases with vitamin D deficiency had a considerably higher prevalence of abnormal lipid profiles with relation to HDL-cholesterol. The findings of earlier investigations agreed with this finding. [22]

Obesity, metabolic syndrome, and chronic inflammation are clinical symptoms of PCOS that are linked to vitamin D insufficiency. [23-26] Our results showed that, while there was no significant link with obesity, the blood 25(OH)D level in PCOS women was significantly inversely connected with HOMAIR.

The study was conducted in a rural area with a limited sample size, and the majority of the population suffered from generalized malnutrition. Treatment with vitamin D has been proven to improve hyperandrogenism, insulin resistance, follicular formation, and menstrual cycle management. [12] Vitamin D supplementation did not, however, affect the HOMA-IR, LDL, DHEAS, free testosterone, or total testosterone in women with PCOS, according to research by Xue et al. [27] The sample size, vitamin D supplement dosage, participant behaviors, and residence may all be factors in conflicting outcomes. Therefore, to investigate the metabolic role of vitamin D supplementation in PCOS-affected women, multicentre randomized controlled trials with sizable sample sizes are required.

Conclusion

Vitamin D insufficiency is more common in PCOS women than in healthy individuals. Women with PCOS who are vitamin D deficient had significantly higher rates of insulin resistance and elevated HDL-C.

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