Article

The ameliorating effect of vitamin D supplementation on metabolic disturbances in polycystic ovary women

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Abstract

Our study aims to investigate the impact of Vitamin D supplementation on plasma glucose, lipids and other metabolic and endocrine parameters and evaluate the therapeutic effect of Vitamin D and how to improve insulin levels in patients with Polycystic ovarian syndrome (PCOS). A follow-up research was conducted in Kirkuk from January 5th through June 10th, 2022. There were 80 PCOS women in the research, both married and unmarried, ranging in age from 15 to 45 years old. These patients were hospitalized at Azadi Teaching Hospital's obstetrics and gynecology section. In the present study, 80 PCOS was diagnosed based on the presence of two of the Rotterdam criteria: oligo and anovulation, clinical and biochemical signs of hyperandrogenism, and polycystic ovaries in ultrasound, which were defined as the presence of 12 or more follicles measuring 2-9 mm in diameter in each ovary and ovarian volume more significant than 10 cm3. All 80 PCOS patients were given a comprehensive medical examination, anthropometric measurements, such as weight and height, and a generic questionnaire to fill out. The formula for calculating the Body Mass Index (BMI) was weight $(kg)/height^2$ (m^2). The mean BMI for PCOS patients was 28.2 (Kg /m²), and the mean for age 30. In our study, insulin level decreased significantly at P value (0.0045) with statically no correlation between vitamin D and insulin after three months of vitamin D administration, while insulin resistance level was reduced significantly at P value (< 0.0001) with a negative correlation between vitamin D and insulin resistance, while serum FSB level was raised significantly at P value < (0.0001).ConclusionThe majority of women with PCOS who enrolled in this study were within the childbearing age, and the majority of PCOS women were overweight. Vitamin D was most deficient in PCOS women. In PCOS women, hirsutism, acne, and irregular menstrual cycle were more frequent.

Keywords: Polycystic ovarian syndrome; vitamin D; insulin Body Mass Index

Introduction

Polycystic ovary syndrome (PCOS) is the most prevalent endocrine system in women of reproductive age, affecting 10% of women globally..2 PCOS's causes are still unknown. Many evidences point to a multi-factorial genesis, including a genetic component. PCOS is a complex condition that has implications for reproductive, metabolic, and psychological characteristics. The fundamental cause of the condition is an anomaly in the ovaries; however, other factors, such as weight and environmental factors, influence the development of particular symptoms. In

PCOS, the ovaries create immature follicles, or fluid-filled sacs containing an immature oocyte. However, there is insufficient hormonal stimulation for the immature oocyte to mature into a mature egg that can be released during ovulation. PCOS causes women to create more male hormones than they should. This hormonal imbalance causes them to miss menstrual periods, making it difficult for them to conceive. Hair growths on the face and body, as well as baldness, are all symptoms of PCOS.

Furthermore, it has been linked to long-term health issues such as diabetes and heart disease(1-4). According to a 2003   National Institutes of Health (NIH) meeting, any two of the following three factors are sufficient to support the diagnosis of PCOS: particular morphology of polycystic ovaries in ultrasonography findings, hyperandrogenism, and oligo- or polycystic ovaries amenorrhoea5. PCOS is a complicated and variable metabolic syndrome presentation with various phenotypes. The Iraqi patients had lower levels of estradiol (E2) and follicular stimulating hormone (FSH), which inhibited ovulatory function and resulted in infertility. Hyperandrogenism is the hallmark of the disease, and there is no doubt that an increase in androgen synthesis by ovarian theca cells beyond the normal range leads to hirsutism. (6). Most importantly, insulin resistance is not the same for everyone, and some women with insulin resistance develop PCOS while others do not. According to some experts, obesity-related insulin resistance changes the function of the hypothalamus and pituitary gland in the brain, boosting the production of androgenic hormones, which leads to PCOS. With or without PCOS, excessive production of androgenic hormones is an independent risk factor for female infertility and ovarian dysfunction(7). Vitamin D (Vit. D)   promotes calcium and phosphate absorption and metabolism, essential for bone and muscle function(8,9). Vitamin D can be made in two ways: through intestinal absorption and by endogenous synthesis from a precursor of 17-hydroxyl cholesterol on the skin when exposed to ultraviolet radiation 11. Vitamin D deficiency raises the risk of obesity, cardiovascular disease, type 2 diabetes, cancer, autoimmune, infectious disease, and psychological disorders, among other chronic medical issues3. Some studies have revealed a link between vitamin D levels in the blood and obesity, as well as other metabolic parameters in women with PCOS, such as fasting glucose levels, fasting insulin resistance, high blood pressure, lipid problems, fertility, and other clinical and laboratory parameters, Insulin resistance, ovulatory and menstrual regulation, decreased pregnancy rate, hirsutism, hyperandrogenism, obesity, and increased cardiovascular disease were all found to be connected with a lower 25(O.H.)D level (10-12).

Aim of study

We aimed to investigate the impact of Vit. D   supplementation on the plasma glucose, lipid and other metabolic and endocrine parameter also to evaluate the therapeutic effect of Vit. D and how to improve hormonal levels in patients with PCOS.

Materials and Methods

A follow-up research was conducted in Kirkuk from January 5th through June 10th, 2022. There were 80 PCOS women in the research, both married and unmarried, ranging in age from 15 to 45 years old. These patients were hospitalized at Azadi Teaching Hospital's obstetrics and gynecology section.

Study population

80 PCOS was diagnosed based on the presence of two of the Rotterdam criteria: oligo and anovulation, clinical and biochemical signs of hyperandrogenism, and polycystic ovaries in ultrasound, which were defined as the presence of 12 or more

follicles measuring 2-9 mm in diameter in each ovary and ovarian volume more significant than 10 cm3. All 80 PCOS patients were given a comprehensive medical examination, anthropometric measurements, such as weight and height, and a generic questionnaire to fill out. The formula for calculating the Body Mass Index (BMI) was weight (kg)/height (meters2). Specific laboratory tests exclude patients with metabolic or endocrinology disorders such as thyroid disease, diabetes, hypertension, and hyperprolactinemia from the research. Ovulation induction agents, antiandrogens, antidiabetic, anti-obesity, hormonal drugs and current or previous use were also excluded. For all 80 PCOS patients, vitamin D was administrated, and measurements were repeated after three months.

Statistical Analysis

(Wilcoxon)T-test Statistics was used in a computerized statistical study. Possibility P values less than 0.05 were deemed statistically significant, whereas P values larger than 0.05 were regarded statistically non-significant.

Results

3.1. Polycystic ovarian patients and their age groups

PCOS patients' ages ranged from 15 to 45. 32 (%) were under 20 years, 34(%) were between 20 and 40 years old, and only 20(%) were above 40 years old, with an average age of 30 years, as shown in table 4-1.

Age group	PCOS patients	
	No.	**%**
<20	26	32.5
20-40	34	42.5
>40	20	25
Total	80	100
Mean age 30 years		

Table 1. Distribution of study groups according to age groups.

BMI in PCOS patients were distributed ,3 patient(3.75%) was underweight,25 patients(31.25%)normal, 28 patients (35%) overweight and24 patients(30%) obese with mean range (28.2 Kg/m ²) as showed in table 4-2.

Body Mass Index		PCOS	
		No.	**%**
underweight	<18.5	3	3.75
Normal	18.5-24.9	25	31.25
overweight	25-29.9	28	35
Obese	30≤	24	30
Total		80	100
Mean BMI: 28.2 (Kg /m²)			

Table 2. Distribution of stud groups according to BMI.

In polycystic ovarian patients, as shown in table (4-3), 60pateints (75%) were married, 20 patients (25%) were unmarried, 31pateints (38.45%) were from Rural and 49 patients (61.25%) from Urban,33 patients (41.25%) having a baby and 47 patients (58.75%) non, 36 patients (45%) were hirsutism, and 44 patient (55%) were non-hirsutism,23 patients (28.75%) were normal menstrual cycle,7 patients (8.75%) poly amenorrhea, 41 patients (51.25%) oligiomenorrhea and 9 patients (11.25%) were amenorrhea. Vitamin D levels in polycystic ovarian patients were (6.25%) normal and (93.75%) abnormal.

PCOS patient profile		PCOS (n=80)		VIT.D (n=80)			
		No.	%	Normal		Abnormal	
				NO.	%	NO.	%
Marital status	Married	60	75	1	1.25	59	73.75
	Single	20	25	4	5	16	20
Residence	Rural	31	38.75	3	3.75	28	35
	Urban	49	61.25	2	2.5	47	58.75
Previous birth	Yes	33	41.25	1	1.25	32	40
	No	47	58.75	4	5	43	53.75
Hirsutism	Absent	36	45	0	0	54	67.5
	Present	44	55	5	6.25	21	26.25
Period pattern	Normal	23	28.75	1	1.25	22	27.5
	Poly	7	8.75	1	1.25	6	7.5
	Oligo	41	51.25	3	3.75	38	47.5
	Amenorrhea	9	11.25	0	0	9	11.25

Table 3. shows PCOS patients profile.

Through this study, we obtained a significantly raised VIT.D after three months of VIT.D administration. P value (< 0.0001) and (17.45, 27.52) mean of VIT.D pre and post, respectively, as shown in table (4-4).

Variable	Patient				P. value
	Pre		Post		
	Mean	SD	Mean	SD	
Vitamin D3	17.45	8.347	27.52	7.708	< 0.0001*

*Significant

Table 4. Level of VIT.D in PCOS women before and after VIT.D administration.

Through this study, we obtained a significant reduction in insulin after three months of VIT.D administration. P value (0.0045) and (5.482, 4.713) mean of insulin pre and post, respectively, as shown in a table (4-5).

Variable	Patient				P. value
	Pre		Post		
	Mean	SD	Mean	SD	
Insulin	5.482	3.566	4.713	2.484	0.0045*

* Significant

Table 5. level of insulin in PCOS women before and after VIT.D administration.

Correlation of VIT.D with insulin in PCOS patients

This study showed no significant correlation between vitamin D and insulin in PCOS patients over three months of administration, as shown in Figures (4.1 A and B).
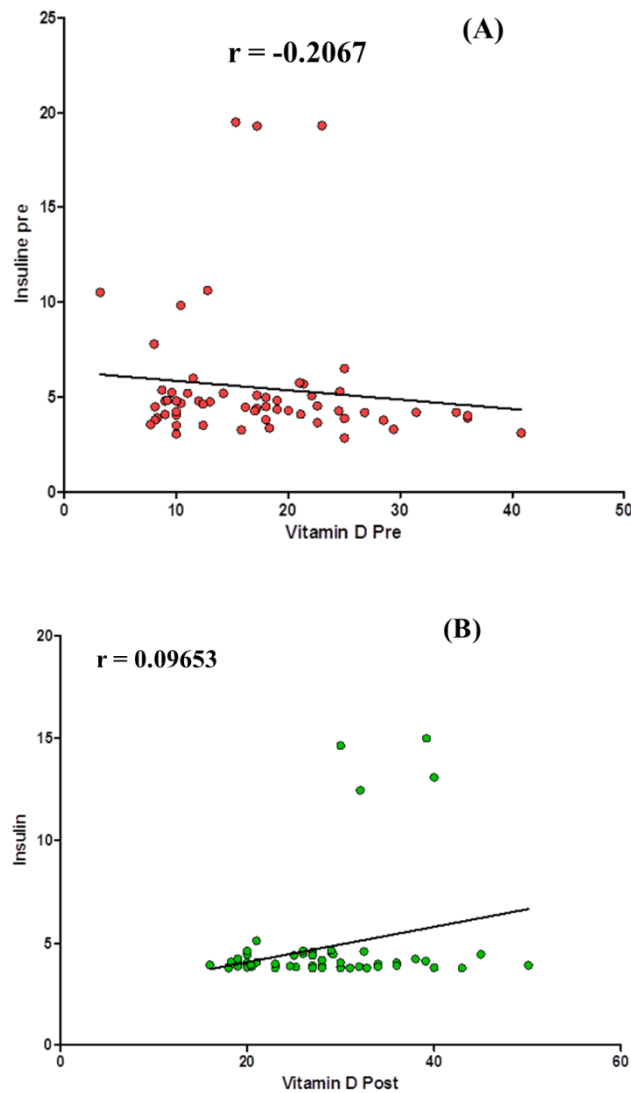

Figure 1. Correlation between VIT.D and insulin in PCOS patients (A) pre and (B) post-VIT.D administration over three-month intervals.

Discussion

Polycystic ovarian syndrome (PCOS) is the most frequent form of persistent anovulation caused by androgen excess, affecting 5 to 10% of women of reproductive age. PCOS is defined as a metabolic disease in which hyperinsulinemia is a significant hallmark, in addition to its reproductive consequences[13,14]. Most women with PCOS were between the ages of 20 and 40, implying that women of a younger age group are more prone to PCOS. This finding could be related to the fact that the ovaries are more physiologically active in women of childbearing age and, thus, more prone to cystic change, as found by Banu Ucar et al.,2006; Zbaar,2022 [15,16]. , who found that the mean age group for women with PCOS was (23.53±5.51) years. While Al-Gareeb,2015[17] reported that the age of women with PCOS was (27.4±7.5) years. In our study, insulin level decreased significantly at a P value (0.0045) with statically significant no correlation between vitamin D and insulin after three months of vitamin D administration, while insulin resistance level was reduced significantly at a P value (< 0.0001) with negative correlation between vitamin D and insulin resistance, while serum FSB level was raised significantly at P value < (0.0001), many studies have been conducted clarify these finding especially the mechanisms involved in metabolic disorder in women with PCOS[18-19].

Vitamin D deficiency associated with impaired glucose tolerance, insulin secretion, and I.R. and compensatory hyperinsulinemia were found to be standard features in women with PCOS. PCOS women are at risk for developing Type 2 diabetes [20], in agreement with our study. [21] found that vitamin D deficiency may exacerbate symptoms of PCOS, insulin resistance, ovulatory and menstrual irregularities, lower pregnancy success, hirsutism, hyperandrogenism, obesity and elevated cardiovascular disease risk factors, and there is some but limited evidence for a beneficial effect of vitamin D supplementation on menstrual dysfunction and insulin resistance in women with PCOS. The possible effects of vitamin D on glucose metabolism are stimulation of insulin secretion, suppression of PTH and different effects on insulin sensitivity on receptor levels [20]. The presence of VDR and vitamin D binding globulins (VDBG) in pancreatic islets and the relationship of certain allelic variations in the VDR genes with glucose tolerance and insulin secretion suggest a role of vitamin D in the pathogenesis of Type 2 diabetes. Vitamin D may stimulate pancreatic insulin secretion. Administration of calcitriol to vitamin D-deficient rats increases insulin secretion and decreases blood glucose response to intravenous glucose loading tests. These stimulatory effects of vitamin D on insulin secretion may be noticeable when calcium levels are adequate, and intracellular calcium may play a role in insulin secretion. Vitamin D deficiency mainly causes secondary hyperparathyroidism. Increased PTH activity is associated with reduced insulin sensitivity. Another effect of vitamin D on glucose metabolism is peripheral tissue glucose uptake via VDR receptors. The skeletal muscle is a key component in the I.R. and may be involved in pathogenesis since VDR has been identified in this tissue. Vitamin D regulates gene transcription through vitamin D receptors (VDRs), widely distributed throughout body tissues, including the ovaries. Genetic polymorphisms associated with VDRs have been linked to SHBG, testosterone, and insulin serum luteinizing hormone (L.H.) levels [22,23,24,25].

Conclusion

Most women with PCOS who enrolled in this study were under childbearing age. The study showed that the majority of PCOS women were overweight. Vitamin D was most deficient in PCOS women. Hirsutism, acne, and irregularity of the menstrual cycle frequently occur in PCOS women.

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