



## ASSOCIATION OF VITAMIN D SUPPLEMENTATION WITH ANTHROPOMETRIC, BIOCHEMICAL AND CLINICAL CHARACTERISTICS IN PCOS WOMEN

Fatima Amjad<sup>1\*</sup>, Izba Asif<sup>2</sup>, Madiha Ghazanfar<sup>3</sup>, Maimoona Waheed<sup>4</sup>, Zoha Imtiaz<sup>5</sup>, Nabila Iftikhar<sup>6</sup>, Shahzadi Uzma Khan<sup>7</sup>, Asma Sohail<sup>8\*</sup>, Haseeb Ahmed<sup>9\*</sup>

<sup>1</sup>Riphah International University, Islamabad Pakistan

<sup>2,3,4,6,9\*</sup>IBADAT International University, Islamabad Pakistan

<sup>7,8\*</sup>Institute of Food and Nutritional Sciences, PMAS Arid Agriculture University, Rawalpindi Pakistan

<sup>5</sup>National University of Medical Sciences (NUMS), Rawalpindi Pakistan

**\*Corresponding Author :** Fatima Amjad , Asma Sohail, Haseeb Ahmed

\*Riphah International University, Islamabad Pakistan , Institute of Food and Nutritional Sciences, PMAS Arid Agriculture University, Rawalpindi Pakistan , IBADAT International University, Islamabad Pakistan

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### ABSTRACT

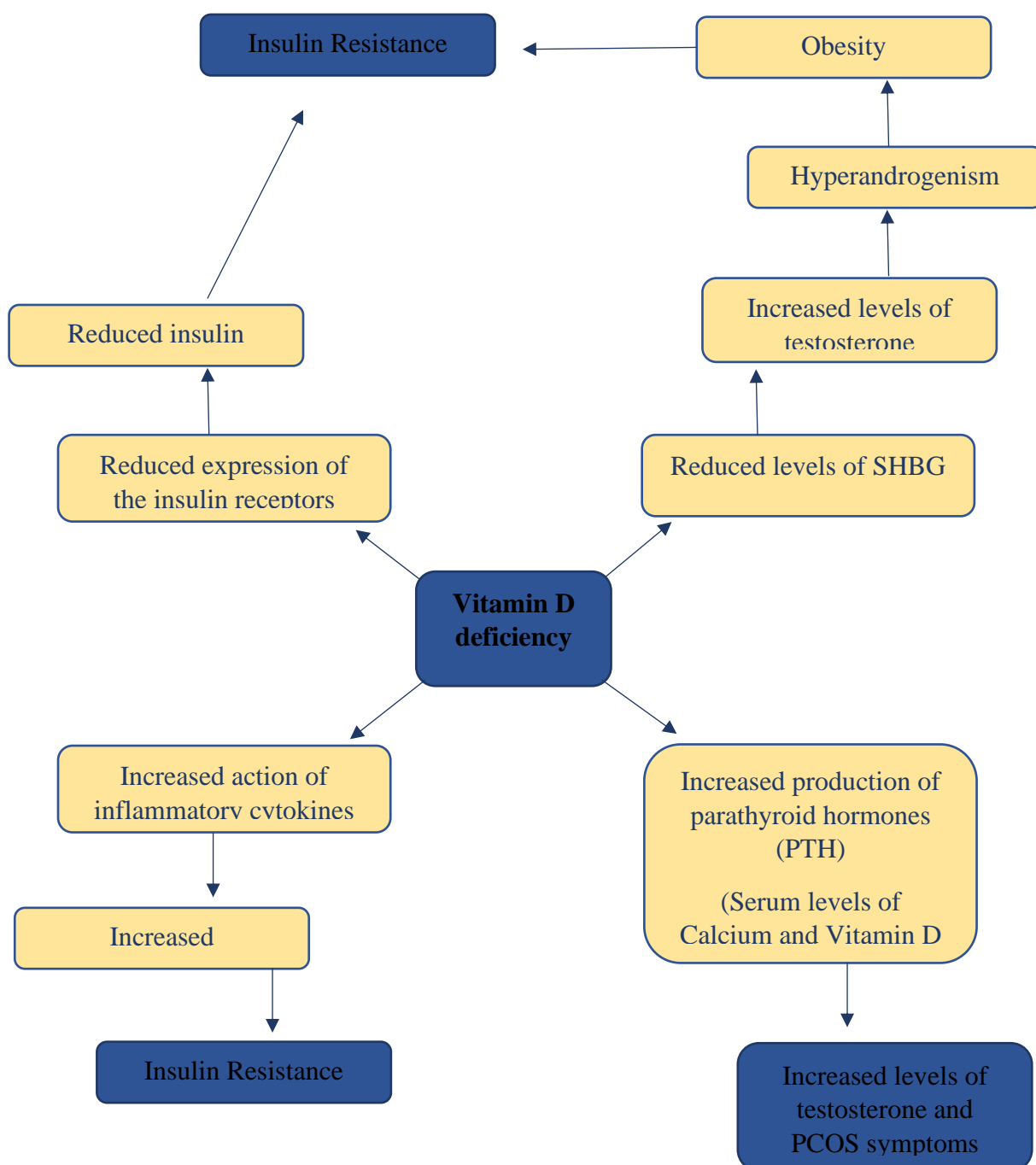
Suffering from health problems such as Polycystic Ovary Syndrome (PCOS) requires a great attention to the nutritional therapy. The women with PCOS undergo hormonal and metabolic changes, leading to various symptoms including irregular menstrual cycle, hirsutism, acne, baldness etc. Women with PCOS may also experience increased body weight and reduced serum Vitamin D levels which may even worsen the symptoms. Reduced vitamin D levels in body are considered to be link with increased insulin resistance and other symptoms. This study aims to find out the efficacy of vitamin D supplementation on PCOS symptoms with a focus on the anthropometric, biochemical and clinical characteristics in women with PCOS. Literature from 2018 to 2024 was searched using Pub Med, Google Scholar and Science Direct. As per the literature, studies show that even only 5% reduction in the body weight and improving the levels of vitamin D in the body can result in improved symptoms of PCOS including insulin resistance, fasting plasma glucose (FPG) levels, fasting blood insulin levels and menstrual cycle.

**Keywords:** PCOS, Vitamin D Supplementation, Anthropometric Characteristics, Biochemical Values, Clinical Characteristics.

### INTRODUCTION

Polycystic Ovary Syndrome is an endocrine disorder, regarded as raised levels of androgens (male hormones), leading to the development of many symptoms such as insulin resistance (IR), hirsutism, baldness, acne, irregular menstruation and weight gain [1]. Hyperandrogenism is the main characteristic feature of PCOS in which there is increased production of androgens by the ovaries and adrenal glands, possibly due to imbalance in the LH to FSH ratio and increased production of insulin hormone [2].

A numerous studies have been conducted on the causes, avoidance and management of Polycystic Ovary Syndrome. The etiology of PCOS is not known but there are some risk factors that include obesity and insulin resistance [3]. There is a close link between obesity and PCOS development. Obesity is found to have an effect on androgen and insulin levels. The circulating levels of androgen and insulin tend to be higher in obese women suffering from PCOS [4]. Insulin resistance is considered to be linked with increased levels of androgen. Insulin resistance and hyperandrogenemia form a vicious cycle [5]. Insulin resistance causes hyperinsulinemia (increased levels of serum insulin), leading to increase in androgen levels which in turn further exacerbates the insulin resistance. Some scientific studies show that lifestyle intervention and diet rich in certain nutrients like vitamin D form the baseline of the PCOS treatment [6]. Unfortunately, women with PCOS are commonly found to be deficient in Vitamin D and the lower level is linked with high risk of insulin resistance and other symptoms in them [7]. Figure 1 shows how vitamin D deficiency might lead to PCOS.

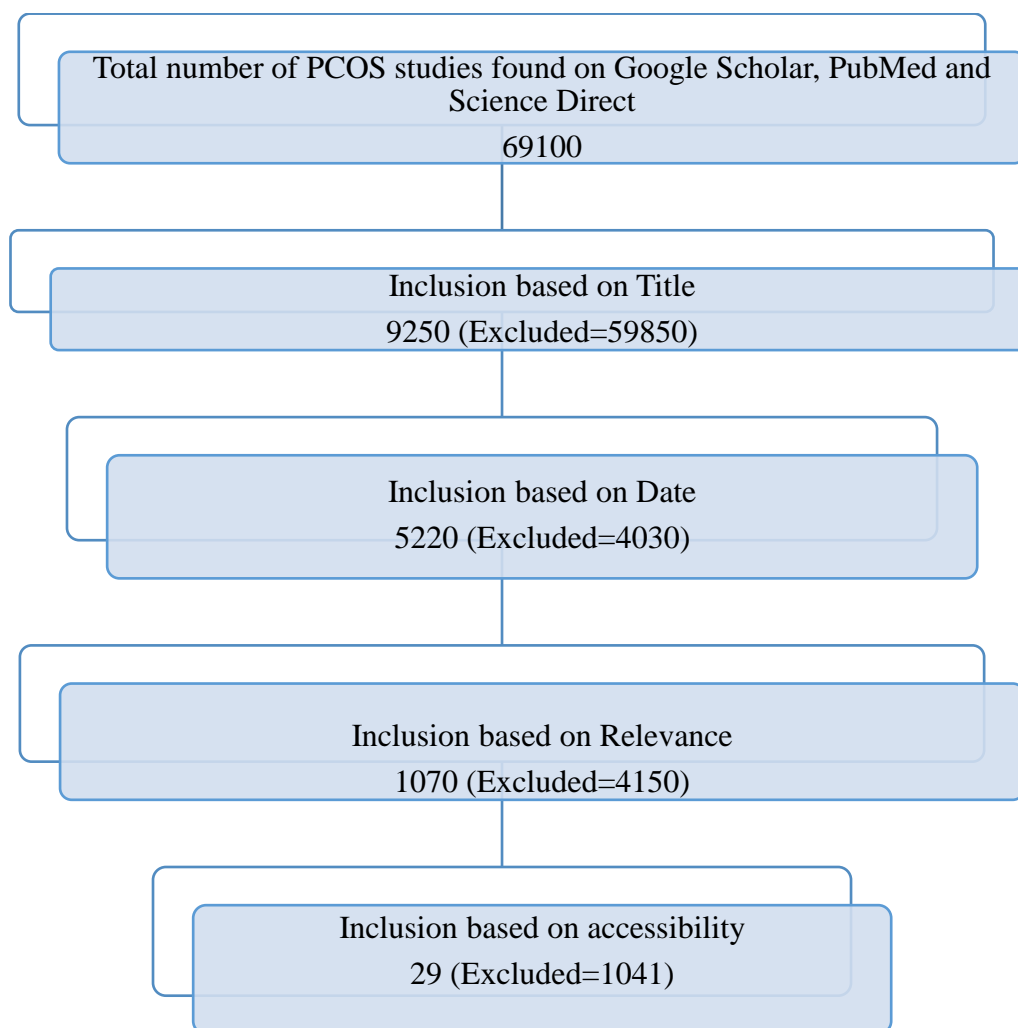


**Fig. 1. Mechanism of PCOS development due to lack of vitamin D**

A 25-hydroxyvitamin (25-OH)D blood concentration of less than or equal to 20 ng/ml is considered vitamin D deficiency, whereas a range of 20 ng/ml to 30 ng/ml is considered as insufficient amount of vitamin D [8]. Lack of vitamin D may cause reduction in insulin sensitivity and development of visceral obesity and therefore contributing to the pathophysiology of PCOS [9]. Thus, the purpose of present paper was to review the potential roles of vitamin D supplementation in improving the symptoms of PCOS. The review focuses on the efficacy of vitamin D on the anthropometric measurements, biochemical measurements and the clinical characteristics of the polycystic ovarian syndrome.

**Methods:**

This study was based on reviewing the research papers and review articles related to PCOS, the dietary patterns of the patients and efficacy of vitamin D supplementation on the symptoms of PCOS. Literature from 2018 to 2024 was reviewed using databases such as Google Scholar, PubMed, and Science Direct and the terms ‘PCOS’, ‘lifestyle intervention’, ‘vitamin D supplementation’ and ‘insulin resistance’ were used. The inclusion criteria were made based on the title, date of publish, relevance and the accessibility to read the articles. The articles that were published between 2018 and 2024, the articles that were published in English, and the articles that had full access to read were included. All other articles were excluded. The articles were selected in accordance with their titles. Those with relevant titles were included and those with irrelevant titles were excluded. This was followed by the reading and analysis of the abstracts and articles respectively.



**Fig. 2.**

## RESULTS AND DISCUSSION

### LIFESTYLE MODIFICATION AND SUPPLEMENTATION OF VITAMIN D

The current study demonstrated the role of lifestyle intervention and vitamin D supplementation in improving symptoms of PCOS. A balanced diet and healthy eating practices are crucial for PCOS therapy [10]. The amount of vitamin D in the body might also show a role in the emergence of metabolic abnormalities in PCOS. It is indicated that a negative correlation exists in vitamin D status and PCOS metabolic issues [11].

#### Efficacy on Anthropometric Measurements

Low levels of 25(OH)D may make PCOS symptoms worse, such as obesity, insulin resistance, irregular menstruation, infertility, hyperandrogenism, and an increased risk of cardiovascular illnesses [12]. One well-known risk factor for vitamin D insufficiency is obesity. A counter association between BMI and serum 25(OH)D levels in PCOS subjects is observed [13]. The body weight, BMI, WC, HC are found to be considerably decreased with vitamin D supplements per day in PCOS patients [14]. Supplementing vitamin D and calcium along with metformin to the infertile women with PCOS is considered to be effective. Menstrual irregularities, follicular maturation, and infertility are also found to be better controlled by vitamin D supplementation [15]. Serum vitamin D level is observed to be inversely linked with body fat mass, insulin resistance and androgen levels of serum. This represents a beneficial effect on menstrual cycle and reproductive health of PCOS women [16].

#### Efficacy on Biochemical Levels

Vitamin D has a role in improving the insulin resistance. A significant association is suggested between IR and serum levels of vitamin D in PCOS women. Notable improvements are found to occur in insulin sensitivity, FPG levels, fasting blood insulin levels and HOMA-IR scores. This highlights the important role of vitamin D in the management of PCOS symptoms [17]. Supplementing 50,000 IU of vitamin D in deficient women, with insulin resistance, was associated with a substantial drop in FPG levels. This depicts the positive link between the intake of vitamin D and improved IR [18].

Insulin resistance and hyperandrogenism are found to be affected by vitamin supplementation. Vitamin D treatment was reported to decrease insulin resistance and hyperandrogenism and also improved lipid metabolism [19]. The efficacy of vitamin D supplement was investigated on PCOS women. It was determined that the difference in FPG before and after supplementing vitamin D was statistically substantial. After taking vitamin D supplements, there was a substantial improvement in insulin sensitivity as well as serum fasting insulin. This illustrates the beneficial impact of vitamin D on the biochemical parameters of PCOS [20]. The vitamin D3 administration was ascertained on the parameters of glucose metabolism in PCOS-afflicted obese women after a 10- to 12-hour overnight fast. Following alpha calcidol therapy, the first phase of insulin secretion dramatically increased. The lipid profile showed a positive statistically significant shift as well. Therefore, it was reported that alphacalcidol, a vitamin D3, could be used to improve symptoms of PCOS [21].

The efficacy of supplementing vitamin D in PCOS patients' metabolic condition was examined at the start and end of the trial, nutritional biomarkers were quantified and it was reported that vitamin D significantly lowered insulin and FPG [22]. Enhancing hormones, inflammation, and oxidative stress in PCOS patients seems to be better achieved with vitamin D co-supplementation, low-dose vitamin D supplementation, and frequent daily supplementation [23]. In PCOS-afflicted rats, serum concentrations of follicle-stimulating hormone and estradiol increased dramatically, while levels of testosterone, LH, glucose, insulin, and insulin resistance fell considerably after vitamin D therapy [24].

### Effect on Clinical Characteristics

Supplementation of vitamin D is also found to have beneficial effect on the clinical characteristics of polycystic ovary syndrome. It was reported that level of blood 25(OH)D was considerably improved and the frequency of a regular menstrual cycle significantly improved but no change was observed in the androgen profile [25]. In order to ascertain if changes in TGF-1 to soluble endoglin (sENG) ratio levels correlate with a reduction in PCOS clinical symptoms, researchers looked at the impact of supplementing the patients with vitamin D on TGF-1 bioavailability in women with PCOS. The vitamin D level considerably increased and returned to normal following vitamin D supplementation. The time between menstrual cycles, Ferriman-Gallwey score, triglycerides, and TGF-1 to sENG ratio all significantly decreased after the vitamin D supplementation [26].

It was examined how vitamin D medication affects the levels of androgen and hirsutism in PCOS-afflicted overweight women. 50,000 IU of vitamin D3 was given to the treatment group per week and it was observed that the menstrual cycle regularity was improved. It was also reported that the hirsutism score, total testosterone, levels of parathyroid hormone, and FAI significantly dropped and that of 25(OH)D and SHBG protein increased [27].

Vitamin D treatment significantly increased the regularity of the menstrual cycle and lowered the level of LH in blood in women with PCOS. It was found that vitamin D supplementation of less than 4000 IU per day, and vitamin D co-supplementation were all associated with lower serum levels of LH. This clarifies the potential effect of vitamin D medication on clinical and biochemical characteristics in PCOS patients [28]. It was also reported that supplementing PCOS women with vitamin D and calcium can improve the clinical characteristics and symptoms of PCOS including menstrual dysfunction, hirsutism, and biochemical features including hyperandrogenism [29].

**Table 1: Effect of Vitamin D supplementation on Anthropometric, Biochemical and Clinical characteristics of PCOS**

Author/ Year	Type of Research	Method	Conclusion
Rad et al., 2018	A randomized clinical trial study	n=58 (case and control), three-day food record was used to assess the data	The body weight, BMI, WC, HC was found to be considerably decreased after vitamin D supplementation per day
Miao et al., 2020	A meta-analysis	A literature searched using databases PubMed and Embase, Web of Science and Ovid Medline	Vitamin D treatment decreased insulin resistance and hyperandrogenism as well as improved PCOS patients' lipid metabolism
Behmanesh et al., 2019	Randomized clinical trial	n=40 (control group and three treatment groups)	Serum concentrations of follicle-stimulating hormone and estradiol increased dramatically, while levels of testosterone, LH, insulin, glucose and IR fell considerably after vitamin D therapy in PCOS-afflicted female rats

Jafari et al., 2018	a randomized, placebo-controlled trial	n=60 (case and control group)	The frequency of a regular menstrual cycle was significantly improved
Al-Bayyari et al., 2021	A randomized placebo controlled clinical trial	n=60 (case and control group)	The menstrual cycle was improved and the hirsutism score, total testosterone, levels of parathyroid hormone, and FAI significantly dropped.

### Conclusion

Women suffering from PCOS commonly have vitamin D deficit which further aggravates the symptoms. Supplementation with vitamin D in women suffering from PCOS is found to reduce the body weight and body mass index along with improvements in the biochemical and clinical characteristics including hyperandrogenism, insulin resistance and menstrual irregularity.

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