

## ORIGINAL ARTICLE

EFFECT OF BODY WEIGHT ON VITAMIN D LEVELS  
IN WOMEN WITH PREMENSTRUAL SYNDROMESalahuddin Shaikh, Ashba Marva\*, Naila Noor\*\*, Farza Farooqui<sup>†</sup>,  
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**Background:** Vitamin D deficiency and higher body weight may contribute to severity of Premenstrual Syndrome (PMS) through hormonal and inflammatory pathways. Objectives of this study were to investigate the relationship between vitamin D levels and body weight in women experiencing PMS. **Methods:** This cross-sectional study was conducted in the Gynaecology Department in collaboration with the Physiology Department, at Isra University Hospital Isra University, Hyderabad, from May to Oct 2023. A total of 200 women aged 15–45 years with a history of PMS were included in the study after consent. Demographic data, age, height were recorded and BMI was calculated, and serum vitamin D3 levels were assessed. The PMS scale was used to determine symptom severity (mild, moderate, and severe). Data were analysed using SPSS-23. **Results:** The mean age of participants was 28.97±6.49 years. Among them, 59% had vitamin D deficiency, while only 4.5% had sufficient levels of vitamin D. A significant inverse association was observed between vitamin D levels and BMI ( $p<0.05$ ). Obese participants were more likely to have vitamin D deficiency, and 35% of those with severe PMS symptoms had deficient vitamin D levels. Pearson correlation analysis revealed a slight negative association between vitamin D levels and BMI ( $r=-0.427$ ,  $p<0.001$ ) and between PMS severity and vitamin D levels ( $r=-0.41$ ,  $p<0.001$ ). **Conclusion:** Vitamin D levels are inversely correlated to BMI and PMS severity suggesting that vitamin D deficiency may contribute to both obesity and worsening PMS symptoms.

**Keywords:** BMI, Body mass index, Obesity, PMS, Premenstrual syndrome, Vitamin D

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## INTRODUCTION

Women frequently experience physical, emotional, and behavioural changes in the days leading up to menstruation. Premenstrual syndrome (PMS) is the term used when these symptoms affect a woman's regular life every month, characterized by physical (bloating, fatigue, breast tenderness), emotional (mood swings, irritability), and behavioural (social withdrawal, difficulty concentrating) changes.<sup>1</sup> PMS affects 8–20% of women of reproductive age worldwide, with moderate to severe symptoms impacting social relationships, work productivity, and overall quality of life.<sup>2,3</sup>

While the exact cause of PMS remains unclear, hormonal fluctuations, lifestyle factors, and nutritional deficiencies are believed to play significant roles.<sup>4</sup> Among these, vitamin D has garnered attention for its multifaceted role in reproductive health and symptom modulation in PMS. Traditionally recognized for its function in calcium metabolism and bone health, vitamin D also exerts significant effects on the immune system, neurotransmitter regulation, and hormonal balance, all of which are implicated in PMS pathophysiology.<sup>5,6</sup>

Vitamin D receptors (VDRs) are widely distributed in various tissues including the ovaries, endometrium, and brain, suggesting its involvement in both reproductive and neurological functions.<sup>7</sup> It helps regulate the synthesis of serotonin, a key

neurotransmitter that influences mood, emotional well-being, and behaviour —factors commonly affected during PMS.<sup>8</sup> Low levels of serotonin are associated with depressive symptoms, irritability, and anxiety, which are hallmark features of PMS.<sup>9</sup> Vitamin D has anti-inflammatory properties that may alleviate PMS-related symptoms such as breast tenderness, bloating, and joint pain by reducing systemic inflammation and modulating the immune response.<sup>10</sup>

In addition to its role in PMS, vitamin D status is closely linked with body weight. Obese individuals often exhibit lower serum vitamin D levels due to several mechanisms: sequestration in adipose tissue —as a fat-soluble vitamin, vitamin D is stored in body fat, reducing its bioavailability in circulation. Decreased synthesis and metabolism —obesity may impair the conversion of vitamin D to its active form due to altered liver and kidney functions. Reduced outdoor activity —a sedentary lifestyle associated with obesity limits sunlight exposure, which is crucial for endogenous vitamin D synthesis.<sup>11</sup> Conversely, vitamin D deficiency may contribute to weight gain through its effects on insulin resistance, impaired lipid metabolism, and increased inflammation.<sup>12</sup> It has been suggested that vitamin D may influence appetite regulation and energy expenditure, both of which are critical in weight management.<sup>13</sup> Hormonal imbalances, such as those seen

in polycystic ovarian syndrome (PCOS), can exacerbate menstrual irregularities and PMS symptoms due to their association with obesity and vitamin D deficiency.<sup>14,15</sup>

Given the overlapping roles of vitamin D and body weight in PMS, this study aims to investigate the relationship between serum vitamin D levels and body mass index (BMI) among women with PMS. Understanding this relationship could provide insights into potential dietary or lifestyle interventions, such as vitamin D supplementation and weight management strategies, to alleviate PMS symptoms and improve overall well-being.

## MATERIAL AND METHODS

This cross-sectional study was conducted in the Gynaecology Department in collaboration with the Physiology Department, Isra University, Hyderabad, from May to Oct 2023. A total of 200 women aged 15–45 years with a history of PMS were included in the study. The PMS was defined as the presence of recurrent physical, emotional, and behavioural symptoms occurring in the luteal phase of the menstrual cycle significantly affecting daily activities and resolved after menstruation, in the last 6 months.

A structured proforma was used to collect data, which included demographic details (age, marital status, BMI), medical history (PMS severity, vitamin D levels, co-morbid conditions), and lifestyle factors (physical activity, dietary habits, and sun exposure). The severity of PMS was assessed using the Premenstrual Syndrome Scale<sup>16</sup>, categorizing participants into mild, moderate, and severe PMS groups. Vitamin D3 levels were measured in collaboration with a diagnostic and research facility, Jamshoro/Hyderabad. Vitamin D level below 20 ng/mL was considered deficient, 20–30 ng/mL was considered insufficient, and  $\geq 30$  ng/mL was considered sufficient.

Data were analysed using SPSS-23. Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as Mean $\pm$ SD. Chi square test and Pearson correlation analysis were applied to see the association between vitamin D levels and BMI, and  $p < 0.05$  was considered statistically significant.

## RESULTS

The mean age of the participants was 28.97 $\pm$ 6.49 years. Among the 200 participants, 127 (63.5%) were married, and 73 (36.5%) were unmarried. Regarding BMI, 75 (37.5%) had a normal BMI, while 71 (35.5%) were obese. Severe PMS symptoms were observed in 77 (38.5%) participants, while 64 (32%) had mild PMS. The majority (118, 59%) of participants, had vitamin D deficiency, whereas only 9 (4.5%) had sufficient vitamin D levels. (Table-1).

Vitamin D levels showed a significant variation across BMI categories ( $p=0.001$ ) with a higher prevalence of deficiency in obese individuals. Among normal-weight participants, 41 (20.5%) had insufficient vitamin D levels, whereas 56 (28%) of obese participants had vitamin D deficiency. All obese participants had either vitamin D deficiency or insufficiency, with none having sufficient levels, highlighting a strong inverse relationship between obesity and serum vitamin D levels. (Table-2).

Among participants with mild PMS, 34 (17%) had insufficient vitamin D, while 70 (35%) of those with severe PMS had vitamin D deficiency. A moderate negative correlation ( $r = -0.41$ ,  $p < 0.001$ ) was found between PMS severity and vitamin D levels. (Table-3).

Table-4 shows the correlation between vitamin D levels and BMI, indicating a statistically significant moderate negative correlation ( $r = -0.427$ ,  $p < 0.001$ ). Similarly, a moderate negative correlation ( $r = -0.41$ ,  $p < 0.001$ ) was found between PMS severity and vitamin D levels suggesting that lower vitamin D levels are associated with both higher BMI and increased PMS severity.

**Table-1: Clinical data of the patients (n=200)**

Variables	Frequency	Percentage
<b>Marital status</b>		
Married	127	63.5
Un-married	73	36.5
<b>BMI</b>		
Under-weight	17	8.5
Normal	75	37.5
Overweight	37	18.5
Obese	71	35.5
<b>PMS score</b>		
Mild	64	32.0
Moderate	59	29.5
Severe	77	38.5
<b>Vitamin D level</b>		
Deficiency	118	59.0
Insufficiency	73	36.5
Sufficiency	9	4.5

**Table-2: Vitamin D levels according to BMI (n=200)**

BMI	Vitamin D status			Total	p
	D	InS	S		
Underweight	11 (5.5)	4 (2.0)	2 (1.0)	17 (8.5)	0.001
Normal weight	23 (11.5)	41 (20.5)	11 (5.5)	75 (37.5)	
Overweight	17 (8.5)	19 (9.5)	1 (0.5)	37 (18.5)	
Obesity	56 (28.0)	15 (7.5)	0 (0.0)	71 (35.5)	

Key: D=deficiency, S=Sufficiency, InS=Insufficiency

**Table-3: Vitamin D levels according PMS scores**

PMS score	Vitamin D status			Total	p
	D	InS	S		
Mild	25 (12.5)	34 (17.0)	5 (2.5)	64 (32.0)	0.001
Moderate	24 (12.0)	32 (16.0)	3 (1.5)	59 (29.5)	
Severe	70 (35.0)	4 (2.0)	3 (1.5)	77 (38.5)	

**Table-4: Correlation between vitamin D and BMI**

	Vitamin D	BMI	PMS Severity
Vitamin D	1	-0.427	-0.41
BMI	-0.427	1	-
PMS Severity	-0.41	-	1

Correlation is significant at the 0.01 level (2-tailed)

## DISCUSSION

Premenstrual syndrome is a common condition affecting women of reproductive age, often characterized by physical, emotional, and behavioural symptoms. Lack of vitamin D increases the likelihood of weight gain due to decreased intestinal absorption and impaired hydroxylation in adipose tissue.<sup>17</sup> A well-established correlation exists between declining vitamin D levels and increased body weight. Women suffering from PMS are particularly prone to weight gain, with obesity, sedentary lifestyles, and poor diets contributing to low calcifediol levels. In our study, a moderate negative correlation was observed between PMS severity and vitamin D levels, suggesting that lower vitamin D levels may be associated with more severe PMS symptoms.

PMS is a common disorder among women of reproductive age, yet its precise aetiology remains unclear. Vitamin D plays a crucial role in immune regulation and may reduce inflammation during the menstrual cycle.<sup>18</sup> Increased adipose tissue accumulation in PMS may result from neurological, endocrine, and behavioural pathways. Several studies have demonstrated that women with PMS or recurrent menstrual symptoms are more likely to have higher body weight or be obese compared to those without PMS.<sup>19</sup> However, it remains uncertain whether rapid weight gain or weight cycling (fluctuations in body weight) increases the risk of PMS independent of total body fat percentage.

Husna *et al*<sup>20</sup> reported that obesity may influence the severity of specific menstrual symptoms. Arab *et al*<sup>21</sup> concluded that individuals with PMS tend to have lower levels of vitamin D, calcium, and magnesium. Vitamin D supplementation was found to alleviate PMS symptoms, emphasizing its potential role in PMS management.<sup>21</sup> Given the high prevalence of PMS, emphasis should be placed on improving the health and nutritional status of young women.

In the current study, vitamin D levels were significantly and inversely correlated with BMI. Overweight and obese individuals exhibited a decline in serum 25(OH)D levels as BMI increased. Previous studies have reported high prevalence of vitamin D insufficiency among overweight and obese individuals, particularly in females.<sup>22</sup> Adolescents with vitamin D deficiency may be at an increased risk of obesity, highlighting the importance of vitamin D supplementation in this population.

Lagowska *et al*<sup>23</sup> examined vitamin D levels in young women with varying body weights and their association with menstrual cycles. Among those with low vitamin D levels, 40% reported prolonged menstrual cycles, 27% had oligomenorrhea, and 13% experienced amenorrhea. In contrast, only 12% of

individuals in the normal vitamin D group reported menstrual irregularities, with 6% experiencing amenorrhea and 6% reporting oligomenorrhea. Women with serum 25(OH)D levels below the recommended 30 ng/mL had a nearly five-fold increased risk of menstrual irregularities compared to those with sufficient levels.<sup>23</sup> Low vitamin D levels have been linked to a higher prevalence of menstrual irregularities, which may exacerbate PMS symptoms. Addressing vitamin D deficiency through supplementation could be a crucial intervention for managing PMS and promoting overall reproductive health.

Despite the insights provided by this study, several limitations should be acknowledged. The cross-sectional design limits our ability to establish a causal relationship between vitamin D levels, PMS severity, and BMI. Longitudinal studies are needed to determine whether low vitamin D levels contribute to PMS and weight gain over time. The study relied on self-reported PMS symptoms, which may introduce recall bias. Future research should incorporate standardized diagnostic criteria or clinical assessments for a more objective evaluation of PMS severity. While we identified a significant association between vitamin D and BMI, other confounding factors such as dietary intake, physical activity levels, and genetic predisposition were not extensively controlled. The sample size limits the generalisability of our findings.

## CONCLUSION

There is a significant inverse relationship between vitamin D levels and BMI in women with PMS, suggesting that lower vitamin D levels may be linked to increased PMS severity and weight gain. Targeted interventions such as supplementation and dietary modifications may help improve PMS symptoms and overall well-being of the women.

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