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Evaluation of Serum Vitamin D levels and their correlation with menstrual irregularities in reproductive-aged women: A cross-sectional study

Dr. Lalitha Chandrashekhar Panicker
Assistant Professor, Department of Obstetrics and Gynaecology, Travancore Medical College, Kollam, Kerala, India

Dr. Prasanna Kumari K A
Assistant Professor, Department of Obstetrics and Gynaecology, Travancore Medical College, Kollam, Kerala, India
Corresponding author: prasannakumaridr@gmail.com

***Abstract*---Background:** Vitamin D plays a vital role in female reproductive health, including regulation of the menstrual cycle. Hypovitaminosis D has been implicated in disorders such as polycystic ovary syndrome (PCOS) and other menstrual irregularities. This study aims to evaluate the serum levels of vitamin D in reproductive-aged women and investigate its association with various patterns of menstrual disturbances. **Materials and Methods:** A cross-sectional study was conducted on 120 women aged 18–40 years attending the gynecology outpatient department over six months. Participants were categorized into two groups: those with regular menstrual cycles (n=60) and those with irregular cycles (n=60). Detailed menstrual histories were obtained, and serum 25-hydroxyvitamin D [25(OH)D] levels were measured using a chemiluminescent immunoassay. Statistical analyses, including mean comparisons and Pearson correlation, were performed using SPSS version 25.0. **Results:** The mean serum vitamin D level was significantly lower in women with menstrual irregularities (17.8 ± 5.3 ng/mL) compared to those with regular cycles (28.2 ± 6.1 ng/mL) ($p < 0.001$). Among women with irregular cycles, 68.3% were vitamin D deficient (<20 ng/mL), whereas only 21.6% of women with regular cycles showed deficiency. A moderate negative correlation ($r = –0.54$, $p < 0.01$) was observed between vitamin D levels and the severity of menstrual irregularities. **Conclusion:** The study highlights a significant association between low serum vitamin D levels and menstrual irregularities in reproductive-aged women. Screening for

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vitamin D deficiency may aid in the early identification and management of menstrual dysfunction.

***Keywords*---**Vitamin D, Menstrual irregularities, Reproductive health, 25(OH)D, Menstrual cycle, Cross-sectional study.

Introduction

Menstrual irregularities are among the most common gynecological complaints in women of reproductive age, ranging from oligomenorrhea and polymenorrhea to amenorrhea and dysmenorrhea. These disturbances not only affect reproductive health but also have significant implications for overall well-being and quality of life (1). While multiple etiological factors contribute to menstrual irregularities—including stress, hormonal imbalances, thyroid dysfunction, and polycystic ovarian syndrome (PCOS)—emerging evidence highlights a potential role of micronutrient deficiencies, particularly vitamin D (2,3).

Vitamin D, traditionally known for its role in calcium homeostasis and bone metabolism, has been increasingly recognized as a pleiotropic hormone involved in various physiological functions, including immune modulation and reproductive endocrinology (4). The presence of vitamin D receptors (VDRs) in the hypothalamus, pituitary, and ovaries suggests that it may influence the hypothalamic-pituitary-ovarian (HPO) axis and, consequently, menstrual regulation (5). Moreover, vitamin D has been shown to affect ovarian folliculogenesis, insulin resistance, and androgen levels—factors that are closely associated with disorders such as PCOS (6).

Numerous observational studies have indicated a high prevalence of vitamin D deficiency among women with irregular menstrual cycles and PCOS, proposing that hypovitaminosis D may exacerbate menstrual dysfunction by disrupting endocrine pathways (7,8). However, findings have been inconsistent across populations, and there remains a need for further investigation into the direct relationship between serum vitamin D levels and menstrual cycle patterns in reproductive-aged women.

This cross-sectional study aims to evaluate serum 25-hydroxyvitamin D [25(OH)D] levels in women of reproductive age and explore its association with the presence and severity of menstrual irregularities.

Materials and Methods

Study Design and Participants

This cross-sectional study was conducted over a period of six months in the Department of Obstetrics and Gynecology at Travancore Medical College Hospital, Travancore Medicity, Kerala. A total of 120 women aged between 18 and 40 years were recruited after obtaining informed written consent.

Inclusion and Exclusion Criteria

Women with a history of regular or irregular menstrual cycles for the past six months were included. Irregular cycles were defined as cycle lengths shorter than 21 days or longer than 35 days, or having variation exceeding 7 days between cycles. Women who were pregnant, lactating, on hormonal therapy, diagnosed with thyroid dysfunction, or having chronic systemic diseases were excluded.

Grouping and Data Collection

Participants were divided into two groups:

- **Group A (n=60):** Women with regular menstrual cycles
- **Group B (n=60):** Women with menstrual irregularities

A detailed menstrual history, including cycle length, duration, and pattern, was recorded using a structured questionnaire. Anthropometric measurements such as weight, height, and BMI were also documented.

Blood Sample Collection and Analysis

Venous blood samples (5 mL) were collected from all participants under aseptic precautions. Serum was separated and stored at –20°C until analysis. Serum 25-hydroxyvitamin D [25(OH)D] levels were estimated using a chemiluminescent immunoassay technique. According to Endocrine Society guidelines, vitamin D status was classified as follows:

- **Deficient:** <20 ng/mL
- **Insufficient:** 20–29 ng/mL
- **Sufficient:** ≥30 ng/mL

Statistical Analysis

Data were analyzed using SPSS software version 25.0. Quantitative variables were expressed as mean ± standard deviation. Independent t-tests were used to compare serum vitamin D levels between the two groups. Pearson correlation analysis was performed to assess the relationship between vitamin D levels and menstrual patterns. A p-value of <0.05 was considered statistically significant.

Results

A total of 120 reproductive-aged women participated in the study, with 60 women in each group—Group A (regular menstrual cycles) and Group B (irregular menstrual cycles). The mean age of participants was 28.4 ± 4.8 years in Group A and 27.9 ± 5.1 years in Group B, showing no statistically significant difference ($p = 0.58$).

Vitamin D Levels Across Groups

The mean serum 25(OH)D level in Group A was significantly higher at 28.2 ± 6.1 ng/mL compared to 17.8 ± 5.3 ng/mL in Group B ($p < 0.001$), as shown in **Table 1**.

Table 1: Comparison of Mean Serum Vitamin D Levels Between Groups

Parameter	Group A (Regular Cycle)	Group B (Irregular Cycle)	p-value
Mean Vitamin D (ng/mL)	28.2 ± 6.1	17.8 ± 5.3	<0.001*
Vitamin D Deficiency (%)	21.6%	68.3%	–

*Statistically significant ($p < 0.05$)

Vitamin D Status Distribution

The distribution of vitamin D status among the participants is detailed in **Table 2**. A larger proportion of women with irregular cycles were found to be vitamin D deficient (68.3%) compared to only 21.6% in the regular cycle group.

Table 2: Distribution of Vitamin D Status Among Participants

Vitamin D Status	Group A (n=60)	Group B (n=60)
Deficient (<20)	13 (21.6%)	41 (68.3%)
Insufficient	27 (45.0%)	15 (25.0%)
Sufficient	20 (33.3%)	4 (6.7%)

Correlation Analysis

Pearson correlation analysis demonstrated a moderate inverse relationship between serum vitamin D levels and menstrual irregularity scores ($r = –0.54$, $p < 0.01$), indicating that lower vitamin D levels were associated with more severe menstrual disturbances. These findings (Table 1 and Table 2) suggest a strong association between vitamin D deficiency and irregular menstrual patterns in reproductive-aged women.

Discussion

This cross-sectional study demonstrates a significant association between serum vitamin D deficiency and menstrual irregularities in reproductive-aged women. The findings indicate that women with irregular menstrual cycles exhibit notably lower levels of serum 25-hydroxyvitamin D compared to those with regular cycles. These results are consistent with earlier studies that suggest a potential role of vitamin D in the regulation of the female reproductive axis and menstrual health (1,2).

Vitamin D receptors (VDRs) are widely expressed in reproductive tissues such as the ovaries, endometrium, and pituitary gland, implicating vitamin D in the modulation of folliculogenesis, steroidogenesis, and the hypothalamic–pituitary–ovarian (HPO) axis (3,4). Dysregulation of these physiological pathways due to vitamin D deficiency may lead to ovulatory dysfunction and menstrual disturbances (5). Several authors have proposed that vitamin D may improve ovarian reserve and reproductive hormone levels, thus contributing to menstrual cycle regularity (6,7).

In the present study, over 68% of women with irregular cycles were found to have vitamin D deficiency, compared to 21.6% in the regular cycle group. Similar findings were reported by Irani and Merhi, who observed significantly lower vitamin D levels in women with menstrual irregularities and PCOS (8). Another study by Wehr et al. demonstrated that vitamin D supplementation in vitamin D-deficient women with PCOS improved menstrual frequency and insulin sensitivity (9). These findings suggest that vitamin D not only influences reproductive hormone synthesis but also plays a role in metabolic regulation—both of which are critical in maintaining menstrual cycle regularity.

The negative correlation observed between vitamin D levels and menstrual irregularity scores in this study ($r = –0.54$) supports previous work by Maktabi et al., who noted an inverse association between vitamin D status and cycle abnormalities in Iranian women (10). Moreover, vitamin D deficiency has also been linked to elevated levels of luteinizing hormone (LH), androgens, and insulin resistance—all of which contribute to menstrual dysfunction (11,12).

Some proposed mechanisms for this association include vitamin D's role in downregulating anti-Müllerian hormone (AMH), promoting endometrial receptivity, and enhancing insulin sensitivity in granulosa cells (13). Furthermore, vitamin D may also reduce systemic inflammation, which is increasingly recognized as a contributor to reproductive endocrine disorders (14,15). These multi-level effects of vitamin D underscore its potential as a modifiable factor in managing menstrual disorders.

Despite the robust association demonstrated, this study has certain limitations. Being a single-center cross-sectional study, it cannot establish causality. Confounding factors such as dietary habits, physical activity, sun exposure, and seasonal variation in vitamin D levels were not comprehensively evaluated. Future large-scale longitudinal and interventional studies are warranted to confirm the causal role of vitamin D in menstrual health and to explore the therapeutic potential of vitamin D supplementation in affected women.

Conclusion

In conclusion, our findings highlight a strong inverse relationship between serum vitamin D levels and menstrual irregularities in reproductive-aged women. Screening for vitamin D deficiency and ensuring adequate levels through lifestyle modifications or supplementation may offer a simple and cost-effective strategy to manage or prevent menstrual disturbances.

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