

Tinjauan Naratif: Kadar Serum Vitamin D dan Hubungannya dengan Ketidakteraturan Siklus Menstruasi pada Wanita Usia Reproduksi

Narrative Review: Vitamin D Serum Levels and Its Correlation with Menstrual Cycle Irregularities in Women of Reproductive Age

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Abstrak

Ketidakteraturan siklus menstruasi merupakan kondisi yang umum terjadi pada wanita usia reproduktif dan dapat dipengaruhi oleh faktor gaya hidup, hormonal, serta nutrisi, termasuk vitamin D. Defisiensi vitamin D masih banyak ditemukan di seluruh dunia dan diduga menjadi salah satu faktor yang berkontribusi terhadap gangguan menstruasi karena perannya dalam regulasi hormon dan fungsi reproduksi. Selain itu, perubahan gaya hidup modern seperti kurangnya paparan sinar matahari dan pola makan yang tidak seimbang juga dapat memperburuk status vitamin D pada individu. Tinjauan naratif ini bertujuan untuk mensintesis bukti terkini mengenai hubungan antara kadar serum vitamin D dan ketidakteraturan siklus menstruasi pada wanita usia reproduktif. Pencarian literatur dilakukan menggunakan publikasi dalam sepuluh tahun terakhir (2016–2026) yang diperoleh dari database seperti Google Scholar, PubMed (NCBI), dan ScienceDirect. Artikel yang digunakan dalam tinjauan ini dipilih dari jurnal bereputasi yang terindeks di database seperti PubMed dan jurnal nasional terakreditasi SINTA, sehingga kualitas dan kredibilitas sumber dapat dipertanggungjawabkan. Kata kunci yang digunakan meliputi “vitamin D”, “siklus menstruasi”, “menstruasi tidak teratur”, “defisiensi vitamin D”, dan “hormon reproduksi”. Artikel yang disertakan adalah penelitian pada manusia, berfokus pada wanita usia reproduktif, meneliti kadar serum vitamin D terkait siklus menstruasi, dipublikasikan dalam bahasa Inggris, serta tersedia dalam bentuk teks lengkap. Hasil studi yang ditinjau menunjukkan bahwa vitamin D berperan dalam memodulasi hormon reproduksi, terutama hormon luteinizing (LH), yang dapat memengaruhi ovulasi dan keteraturan siklus menstruasi. Kadar vitamin D yang rendah berhubungan dengan ketidakseimbangan hormon yang dapat berkontribusi terhadap ketidakteraturan siklus menstruasi. Secara keseluruhan, temuan ini menunjukkan adanya hubungan yang signifikan antara kadar serum vitamin D dan ketidakteraturan siklus menstruasi pada wanita usia reproduktif. Penelitian lebih lanjut diperlukan untuk mengonfirmasi hubungan tersebut serta mengevaluasi efektivitas intervensi vitamin D dalam memperbaiki keteraturan menstruasi dan kesehatan reproduksi.

Kata kunci : Vitamin D, Siklus Menstruasi, Menstruasi Tidak Teratur, Usia Reproduksi, Keseimbangan Hormonal

Abstract

Menstrual cycle irregularities are common among women of reproductive age and may be influenced by lifestyle, hormonal, and nutritional factors, including vitamin D status. In recent years, vitamin D deficiency has remained a global public health concern, affecting a significant proportion of women. This condition has been suggested as a potential contributor to menstrual disturbances due to the important role of vitamin D in hormonal regulation, calcium homeostasis, and reproductive function. Additionally, inadequate sun exposure and poor dietary intake may further exacerbate vitamin D deficiency. This narrative review aims to synthesize current evidence on the relationship between serum vitamin D levels and menstrual cycle irregularities in women of reproductive age. The literature search was conducted using publications from the last ten years (2016–2026) obtained from databases including Google Scholar, PubMed (NCBI), and ScienceDirect. The included articles were selected from reputable journals indexed in databases such as PubMed and nationally accredited journals (SINTA), ensuring the credibility and quality of the sources. The keywords used were “vitamin D”, “menstrual cycle”, “irregular menstruation”, “vitamin D deficiency”, and “reproductive hormones”. Articles were included if they involved human subjects, focused on women of reproductive age, investigated serum vitamin D levels in relation to the menstrual cycle, were published in English, and were available in full text. The reviewed studies indicate that vitamin D plays a role in modulating reproductive

hormones, particularly luteinizing hormone (LH), which may influence ovulation and menstrual cycle regularity. Low vitamin D levels are associated with hormonal imbalance that may contribute to irregular menstrual cycles. Overall, the findings suggest a significant association between serum vitamin D levels and menstrual cycle irregularities. Further studies are needed to confirm these relationships and to evaluate the effectiveness of vitamin D interventions in improving menstrual regularity and reproductive health.

Keywords: Vitamin D, Menstrual Cycle, Irregular Menstruation, Reproductive Age, Hormonal Balance

Introduction

According to WHO (2024), women of reproductive age are defined as females between the ages of 15–49 who have optimal reproductive function, regardless of whether they are married or unmarried (Herlina & Hartati, 2025). During this period, women experience menstruation as part of the reproductive cycle. The menstrual cycle is a periodic physiological process in the female reproductive system that prepares the body for ovulation and potential pregnancy and is considered an important indicator of reproductive health (Thiyagarajan *et al.*, 2024). According to the International Federation of Gynecology and Obstetrics (FIGO), a normal menstrual cycle should demonstrate consistent frequency, regularity, duration, and volume of menstrual flow (Munro *et al.*, 2018). However, menstrual irregularities such as menorrhagia, dysmenorrhea, abnormal cycle length, and irregular cycles are common among women of reproductive age. The World Health Organization reported that approximately 45% of women experience menstrual cycle disturbances (Winengsih *et al.*, 2023). Meanwhile, the 2023 Indonesian Basic Health Research (Riskesdas) reported that 16.4% of women aged 10–29 years experienced irregular menstrual cycles (Izzah *et al.*, 2024).

Menstrual cycle irregularities have been associated with various medical conditions and diseases, including metabolic syndrome, coronary heart disease, type 2 diabetes mellitus, rheumatoid arthritis, osteoporosis, psychological disorders, reduced quality of life, infertility, anemia, and an increased risk of pregnancy-related hypertensive disorders as well as obstetric

and neonatal complications (Attia *et al.*, 2023). Several factors are known to influence menstrual cycle regularity, including smoking, obesity, and stress (Bae *et al.*, 2018). Other contributing factors include unhealthy dietary habits such as frequent consumption of junk food, lack of physical activity, and skipping breakfast (Akhila *et al.*, 2020). Nutritional factors are also increasingly recognized as important determinants of reproductive health.

One nutritional factor that has gained increasing attention in relation to reproductive function is vitamin D. Vitamin D can be synthesized endogenously in the skin through exposure to ultraviolet B radiation or obtained through dietary intake, supplements, and fortified foods (Benedik, 2021). Recent studies indicate that vitamin D also plays an important role in the endocrine and reproductive systems. This is supported by the presence of vitamin D receptors (Vitamin D Receptor/VDR) in female reproductive tissues, suggesting that vitamin D is involved in the regulation of reproductive processes (Shahrokhi *et al.*, 2016).

Despite its importance, vitamin D deficiency remains a major global nutritional problem. It is estimated that around one billion people worldwide experience vitamin D deficiency, and its prevalence continues to increase. In Indonesia, the prevalence of vitamin D deficiency ranges from 35.1% to 91.7% (Pulungan *et al.*, 2025), which may be attributed to differences in geographical location, sun exposure, lifestyle patterns, clothing habits, and dietary intake across populations. Several studies have reported that low vitamin D levels are associated with menstrual disorders

(Lagowska, 2018). However, existing scientific evidence still shows inconsistent findings regarding the mechanisms linking vitamin D status and menstrual cycle regulation.

This review was conducted in response to the limited number of studies that comprehensively summarize and critically evaluate the relationship between serum vitamin D levels and menstrual cycle irregularities. While vitamin D is widely recognized for its role in bone health, emerging evidence suggests its involvement in reproductive hormonal regulation. However, many existing studies are observational and vary in terms of study design, population characteristics, and measurement methods, which limits the ability to draw definitive conclusions. Understanding the relationship between vitamin D status and menstrual health is therefore important for developing evidence-based nutritional strategies to support women's reproductive health. In addition, healthcare professionals, particularly nutritionists, play an important role in providing education and preventive strategies through nutritional interventions, including promoting adequate vitamin D intake and healthy lifestyle modifications to support reproductive health and prevent menstrual disorders.

Therefore, this narrative review aims to examine and analyze existing literature on the relationship between serum vitamin D levels and menstrual cycle irregularities in women of reproductive age. The findings of this review are expected to provide a comprehensive overview of the role of vitamin D in menstrual health, identify existing research gaps, and support future research as well as evidence-based nutritional interventions in women's reproductive health.

Methods

This study is a literature-based research conducted using a narrative review approach to explore and synthesize existing evidence regarding the correlation between serum vitamin D

levels and menstrual cycle irregularities among women of reproductive age. The literature search was carried out systematically through three major academic databases: Google Scholar, PubMed (NCBI), and ScienceDirect. The included articles were selected from reputable journals indexed in databases such as PubMed and nationally accredited journals (SINTA), ensuring the credibility and quality of the sources. Articles published within the last ten years (2016–2026) were included to ensure the relevance and recency of the literature. The search process used several keywords and combinations, including “vitamin D”, “menstrual cycle”, “irregular menstruation”, “vitamin D deficiency”, and “reproductive hormones”, with the application of Boolean operators such as “AND” and “OR” to refine the search results.

Articles were selected based on predetermined inclusion and exclusion criteria. The inclusion criteria consisted of studies conducted on human subjects, participants categorized as women of reproductive age (15–49 years), studies examining serum vitamin D levels in relation to menstrual cycle characteristics or irregularities, articles published in English, and studies available in full text. Exclusion criteria included animal or in vitro studies, research focusing on populations outside the reproductive age range, and articles that did not specifically analyze the relationship between vitamin D and menstrual cycle characteristics. The article selection process involved an initial screening based on titles and abstracts, followed by a full-text review to assess the relevance of each study to the research objective. Data extracted from each selected article included study design, population characteristics, methods of vitamin D measurement, key findings, and study conclusions. A total of five eligible articles that met all inclusion criteria were analyzed and discussed narratively in this review.

Result and Discussion

The results of the article search (Table 1) represent all studies included in this review, which were published in reputable international journals.

Table 1. Summary of included studies showing vitamin D serum levels and its correlation with menstrual cycle

No	Author & Year	Title	Method	Age	Sample Size	Findings
1	Jukic <i>et al.</i> , 2016	Increasing serum 25-hydroxyvitamin D is associated with reduced odds of long menstrual cycles in a cross-sectional study of African American women.	Cross-sectional	23-34 years	1.102	• Vitamin D Levels: Median 25(OH)D level was 14.7 ng/mL. • Long Cycles: Doubling 25(OH)D levels was linked to a lower risk of long menstrual cycles (over 34 days). Higher vitamin D levels reduce the chance of having longer cycles. • Short and Irregular Cycles: No significant association found with short cycles (aOR: 1.03, 95% CI: 0.82–1.29) or irregular cycles (aOR: 1.46, 95% CI: 0.88–2.41). • Vitamin D Deficiency: 76% of participants were vitamin D deficient (≤ 20 ng/mL). Menstrual Cycle Characteristics: Median cycle length was 28 days, with the majority classified as normal (27-34 days).
2	Jukic <i>et al.</i> , 2018	25-Hydroxyvitamin D and long menstrual cycles in a prospective cohort study.	Prospective Cohort	30-44 years	446	• Vitamin D Levels: 5% were vitamin D deficient (< 20 ng/mL), 69% had levels between 20-39 ng/mL, and 26% had levels ≥ 40 ng/mL. • Long Menstrual Cycles: Vitamin D deficiency was associated with nearly three times the odds of having long menstrual cycles (≥ 35 days) (adjusted odds ratio (aOR): 2.8). • Cycle Length: A 10 ng/mL decrease in

						25(OH)D was linked to a 30% increase in the odds of long menstrual cycles (aOR: 1.3). • Follicular Phase: Lower 25(OH)D levels were associated with a higher probability of a long follicular phase (≥ 18 days). Luteal Phase: Lower levels were also associated with a higher probability of a short luteal phase (≤ 10 days).
3	Lagowska, 2018	The Relationship between Vitamin D Status and the Menstrual Cycle in Young Women: A Preliminary Study	Prospective Study	Mean age: 21.6 years (LD group) and 22.1 years (ND group)	77	• Vitamin D Levels: 79% had low vitamin D levels (< 30 ng/mL); mean 25(OH)D was 18.59 ng/mL (LD group) and 35.74 ng/mL (ND group). • Menstrual Disorders: 40% of the LD group reported menstrual disorders (27% oligomenorrhea, 13% amenorrhoea); only 12% in the ND group had disorders. • Odds of Disorders: Women with low vitamin D had nearly five times the odds of menstrual disorders compared to those with normal levels (OR: 5.0). Body Composition: The LD group had higher body mass and BMI compared to the ND group.
4	Singh <i>et al.</i> , 2021	Association between serum 25-hydroxy vitamin D level and menstrual cycle length	Cross-sectional	18– ≥ 40 years	166	• Vitamin D Levels: 86.7% of women with menstrual irregularities were vitamin D deficient (< 20 ng/mL). • Menstrual Disorders: Women with low vitamin D levels had

and
regularity: A
cross-
sectional
observational
study.

13.3 times higher odds of
having irregular
cycles (OR: 13.30, 95% CI:
5.79-30.60, $p < 0.001$).

- **Cycle Comparison:** Significant difference in mean vitamin D levels between women with irregular cycles (14.56 ng/mL) and regular cycles (21.90 ng/mL) ($p < 0.001$).

Body Composition: No significant difference in vitamin D levels based on age or BMI.

5	Afreen et al., 2022	Relationship Between Serum 25-Hydroxy Vitamin D Level and Menstrual Cycle Irregularity: A Cross-Sectional Study.	Cross-sectional	18-40 years	150
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- **Vitamin D Deficiency:** 53.3% of women with menstrual irregularities were vitamin D deficient (<20 ng/mL).
- **Odds of Irregular Cycles:** Low vitamin D levels were associated with an 18.4 times higher likelihood of having irregular cycles ($p < 0.001$).
- **Mean Vitamin D Levels:** Women with regular cycles had significantly higher mean vitamin D levels (26.8 ± 8.6 ng/mL) compared to those with irregular cycles (19.6 ± 9.0 ng/mL) ($p < 0.001$). **No**

Association with Age or BMI: Vitamin D levels were not significantly associated with age or body mass index

Association Between Vitamin D Serum Levels and Menstrual Cycle Irregularities

Several studies have reported a consistent association between low serum vitamin D levels and menstrual cycle irregularities among women of reproductive age. A study conducted by Jukic *et al.* (2016) among African American women aged 23–34 years indicated that higher serum 25-hydroxyvitamin D [25(OH)D] levels were associated with

lower odds of experiencing prolonged menstrual cycles (>34 days). These findings suggest that vitamin D status may play a role in maintaining normal menstrual cycle length, particularly by reducing the likelihood of extended cycles. However, this study did not find a significant association with shorter menstrual cycles, suggesting that the effect of vitamin D may be more specific to certain types of cycle disturbances rather than menstrual irregularities in general. This may partly explain the differences with other studies that assess broader definitions of irregular cycles.

Further evidence was provided by a prospective cohort study conducted in 2018 by Jukic *et al.*, which demonstrated that women with vitamin D deficiency were more likely to experience prolonged menstrual cycles compared to those with sufficient vitamin D levels. The study also suggested that lower concentrations of 25(OH)D may influence both the follicular and luteal phases of the menstrual cycle, indicating that vitamin D may affect the hormonal regulation involved in different stages of the menstrual process. The use of a prospective cohort design in this study strengthens the temporal relationship compared to cross-sectional studies, indicating that vitamin D deficiency may have a more consistent role in influencing longer cycle patterns rather than overall cycle irregularity.

Lagowska (2018), who observed a high prevalence of vitamin D deficiency among young women, many of whom experienced menstrual disorders such as oligomenorrhea and amenorrhea. Women with lower vitamin D levels showed a higher likelihood of menstrual disturbances compared to those with adequate levels. In addition, the study noted that women with low vitamin D levels tended to have higher body mass index and body weight, suggesting that adiposity may act as a potential confounding factor influencing both vitamin D status and menstrual health. Beyond BMI, other lifestyle-related confounders such as physical activity, dietary intake, and sun exposure may also differ between participants and were not consistently controlled across studies, potentially influencing both vitamin D levels and menstrual cycle patterns.

Evidence from Singh *et al.* (2021) also supports this relationship, showing that vitamin D deficiency was highly prevalent among women experiencing irregular menstrual cycles. The study found significantly lower mean serum 25(OH)D levels in women with irregular cycles compared to those with regular cycles. These findings indicate that insufficient vitamin D levels may increase the risk of menstrual irregularities, highlighting the importance of adequate vitamin D status for reproductive health. However, differences in population characteristics, including geographic location and ethnicity, may influence baseline vitamin D status and should be considered when interpreting these findings across different settings.

Consistent results were also reported by Afreen *et al.* (2022), who found that women with vitamin D deficiency were substantially more likely to experience irregular menstrual cycles compared to those with sufficient vitamin D levels. Lower mean serum vitamin D concentrations were observed among women with menstrual disturbances, further supporting the association between

vitamin D status and menstrual cycle regulation. Nevertheless, variations in measurement methods, including different cut-off values for vitamin D deficiency and reliance on self-reported menstrual cycle data, may contribute to inconsistencies across studies.

Physiological Role of Vitamin D in Reproductive Hormonal Regulation

The relationship between vitamin D and menstrual cycle regulation can be explained through several physiological mechanisms. Vitamin D exerts its biological effects by binding to the Vitamin D Receptor (VDR), which is widely expressed in female reproductive tissues such as the ovaries, endometrium, uterus, and placenta (Shahrokhi *et al.*, 2016). The activation of VDR can influence the expression of genes involved in ovarian function, follicular development, and endometrial regulation.

Vitamin D has also been shown to interact with reproductive hormones that regulate the menstrual cycle, including luteinizing hormone (LH), follicle-stimulating hormone (FSH), and estrogen. These hormones play essential roles in ovulation, follicular maturation, and endometrial changes during the menstrual cycle. Previous studies suggest that adequate vitamin D levels may enhance ovarian responsiveness to FSH, thereby supporting follicular maturation and estrogen production (Shahrokhi *et al.*, 2016). Consequently, insufficient vitamin D levels may disrupt hormonal balance and contribute to menstrual cycle irregularities.

Overall, the majority of studies included in this review indicate that low serum vitamin D levels are associated with menstrual cycle irregularities, particularly prolonged and irregular cycles. Although the evidence consistently suggests a relationship between vitamin D deficiency and menstrual disturbances, most available studies are observational in nature. Therefore, further interventional and longitudinal studies are needed to clarify

the causal relationship and to determine whether vitamin D supplementation could effectively improve menstrual cycle regularity in women of reproductive age. In summary, the observed inconsistencies across studies suggest that the relationship between vitamin D and menstrual cycle disturbances is complex and may be influenced by specific outcome definitions, population characteristics, and unmeasured confounding factors, rather than representing a uniform effect across all types of menstrual irregularities.

Conclusion and Suggestion

This narrative review indicates that low serum vitamin D levels are associated with menstrual cycle irregularities in women of reproductive age. Evidence from several studies suggests that vitamin D deficiency may contribute to menstrual disturbances such as oligomenorrhea, amenorrhea, and irregular or longer cycles. Vitamin D plays an important role in regulating reproductive hormones involved in ovulation and endometrial function, indicating that adequate vitamin D status is essential for maintaining normal menstrual patterns and overall reproductive health. These findings highlight the importance of maintaining sufficient vitamin D levels through adequate sunlight exposure, balanced dietary intake, and appropriate supplementation when necessary as part of efforts to support women's reproductive health.

From a public health perspective, it is recommended that vitamin D supplementation be integrated into adolescent and women's reproductive health programs, particularly through school-based health services, community nutrition programs, and primary healthcare interventions. Educational strategies promoting safe sun exposure, improved dietary intake, and awareness of vitamin D deficiency should also be strengthened as part of preventive efforts targeting young women.

Nevertheless, current evidence is

still largely derived from observational studies with variations in study populations and research designs, which limits causal interpretation. Therefore, further research using more robust study designs, particularly Randomized Controlled Trials (RCTs), is needed to evaluate the direct effect of vitamin D supplementation on menstrual cycle regulation. In addition, longitudinal cohort studies are recommended to better understand the long-term relationship between vitamin D status and reproductive health outcomes among women of reproductive age.

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