

Prevalence of Vitamin D Deficiency in Early Pregnancy: A Cross-Sectional Study at a Tertiary Care Center

Üçüncü Basamak Bir Sağlık Merkezinde Erken Gebelikte D Vitamini Eksikliği Prevalansı: Kesitsel Bir Çalışma

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Abstract

Vitamin D plays a crucial role in calcium metabolism, immune regulation, and cell growth. Deficiency during early pregnancy may adversely affect maternal and fetal health. The aim of this study was to determine the prevalence of vitamin D deficiency and related factors in pregnant women in their first trimester who attended a tertiary care center in Istanbul. A total of 1105 pregnant women who attended the antenatal clinic between January 2020 and January 2024 were retrospectively analyzed. Vitamin D status was classified as sufficient, insufficient, and deficient. Vitamin D deficiency was further categorized as mild, moderate and severe. Serum 25(OH)D levels were analyzed according to age, season, and month. The median age of participants was 29 years (range 17–50), and the median serum 25(OH)D level was 11.1 ng/mL (mean \pm SD: 13.7 \pm 9.2). Vitamin D deficiency (<20 ng/mL) was detected in 78.5% of participants. The lowest levels were observed in winter (median 9.1 ng/mL), and the highest levels were observed in summer (median 11.95 ng/mL). Vitamin D levels were significantly lower in individuals under 30 years of age compared with those aged 30 years and older. In seasonal grouping, vitamin D levels were also significantly lower in the winter–spring period compared to the summer–autumn period. The findings show that vitamin D levels are lower, especially among young pregnant women and during winter months, highlighting the need for monitoring and appropriate preventive strategies for vitamin D deficiency and insufficiency in these groups.

Keywords: 25-Hydroxyvitamin D, Cross-Sectional Study, First Trimester, Pregnancy, Vitamin D Deficiency.

Özet

Vitamin D, kalsiyum metabolizması, immün düzenleme ve hücre büyümesinde önemli bir rol oynar. Erken gebelik dönemindeki vitamin D eksikliği, anne ve fetus sağlığını olumsuz etkileyebilir. Bu çalışmanın amacı, İstanbul’da üçüncü basamak bir sağlık merkezine başvuran birinci trimester gebelerin vitamin D eksikliği prevalansını ve ilişkili faktörleri belirlemektir. Ocak 2020–Ocak 2024 tarihleri arasında antenatal kliniğe başvuran toplam 1105 gebe kadın retrospektif olarak analiz edildi. Vitamin D durumu yeterli, yetersiz ve eksik olarak sınıflandırıldı. Vitamin D eksikliği ayrıca hafif, orta ve ağır olarak kategorize edildi. Serum 25(OH)D düzeyleri yaş, mevsim ve aya göre değerlendirildi. Katılımcıların medyan yaşı 29 yıl (aralık 17–50) olup, medyan serum 25(OH)D düzeyi 11,1 ng/mL (ortalama \pm SS: 13,7 \pm 9,2) idi. Vitamin D eksikliği (<20 ng/mL) katılımcıların %78,5’inde saptandı. En düşük vitamin D düzeyleri kış aylarında (medyan 9,1 ng/mL), en yüksek düzeyler ise yaz aylarında (medyan 11,95 ng/mL) gözlemlendi. Vitamin D düzeyleri 30 yaş altındaki bireylerde, 30 yaş ve üzerindeki bireylere kıyasla anlamlı olarak daha düşüktü. Mevsimsel gruplamada ise kış–ilkbahar döneminde vitamin D düzeyleri, yaz–sonbahar dönemine göre anlamlı derecede daha düşük bulundu. Bu bulgular, özellikle genç gebelerde ve kış aylarında vitamin D düzeylerinin daha düşük olduğunu göstermektedir ve bu gruplarda vitamin D eksikliği ve yetersizliğinin izlenmesi ve uygun koruyucu stratejilerin uygulanması gerektiğini vurgulamaktadır.

Anahtar Kelimeler: 25-Hidroksivitamin D, Kesitsel Çalışma, Birinci Trimester, Gebelik, D Vitamini Eksikliği.

Introduction

Vitamin D plays a crucial role in numerous physiological processes, including calcium absorption. In recent years, it has also been recognized as an important regulator of cell growth, immune function, and cellular metabolism. Physiological, hormonal, and immunological changes during pregnancy lead to alterations in vitamin D metabolism. The first trimester represents a critical period for embryonic organogenesis, placentation, and the establishment of immune tolerance. Consequently, maternal nutrition and micronutrient status are particularly important during early pregnancy. Vitamin D deficiency is highly prevalent worldwide, especially among populations with limited sun exposure, individuals with darker skin pigmentation, women who wear concealing clothing, and those from lower socioeconomic backgrounds.

Vitamin D receptors are present in most tissues and cells throughout the body, highlighting the potential impact of vitamin D deficiency on both maternal and fetal health. Vitamin D deficiency is recognized as a significant public health concern in many countries, with pregnant women considered a high-risk group, exhibiting deficiency rates ranging from 20% to 40% (1). During pregnancy, the requirements for vitamin D and calcium exceed the standard recommended daily allowances (2). Several studies have reported associations between maternal vitamin D deficiency and adverse maternal and fetal outcomes, including gestational diabetes, preeclampsia, preterm birth, low birth weight, and increased rates of cesarean delivery (3-6).

There is currently no consensus regarding vitamin D supplementation during pregnancy, highlighting the need to assess the prevalence of vitamin D deficiency and its associated factors in this population. Therefore, this study was to determine the prevalence of vitamin D deficiency among pregnant women in their first trimester who attended the antenatal clinic at Istanbul Kartal City Hospital between 2020 and 2024.

Material and Method

Serum vitamin D levels measured during the first trimester were retrospectively analyzed in 1105 pregnant women who attended the obstetrics clinic at Istanbul Kartal Dr. Lütfi Kırdar City Hospital between January 2020 and January 2024. Ethical approval for the study was obtained from the Istanbul Kartal Dr. Lütfi Kırdar City Hospital Ethics Committee (dated 24 April 2024, reference no: 2024/010.99/3/6), and relevant patient data were retrieved from the hospital information management system.

All pregnant women who presented before the 12th week of gestation and had their serum vitamin D levels measured were included in the study. Pregnant women with chronic hypertension, a diagnosis of diabetes mellitus, a history of hypertension, gestational diabetes, or intrauterine growth restriction were excluded from the study.

Plasma 25-hydroxyvitamin D [25(OH)D] levels were measured using a chemiluminescent immunoassay. Serum 25(OH)D levels were classified as follows: >30 ng/mL as sufficient, 20–30 ng/mL as insufficient, 11–20 ng/mL as mild deficiency, 5–10 ng/mL as moderate deficiency, and <5 ng/mL as severe deficiency. The ages of the participants, their serum 25(OH)D levels, and the month and season of sample collection were recorded.

Statistical analysis

In the analysis of data, SPSS 22.0 program was used. In descriptive statistics, mean, standard deviation, median, lowest, highest frequency and percentage were used. The distribution of variables was measured with Kolmogorov Smirnov and Shapiro-wilk tests. In the analysis of quantitative independent data, Mann-Whitney U test was used. Spearman correlation analysis was used in correlation analyses. P values below 0.05 were considered statistically significant.

Results

A total of 1105 participants were included in the study. The age of the participants ranged from 17 to 50 years, with a median age of 29 years and a mean age of 30 ± 7 years. The largest age group was 20–30 years,

comprising 47.8% of participants, followed by the 30–40 years age group, which accounted for 40.6%.

In the overall study population, the mean serum 25(OH)D level was 13.73 ± 9.19 ng/mL, demonstrating a high prevalence of

vitamin D deficiency. Seasonal analysis revealed that serum 25(OH)D levels increased in parallel with sun exposure, with a marked decline observed during the winter months (Table 1).

Table 1. The age, serum 25-hydroxyvitamin D concentrations and seasonal distribution of the cases

Age		Min-Max		Mediann	Mean \pm SD / n-%	
		17	-	50	29	30
Age	10-20				38	3.4%
	20-30				528	47.8%
	30-40				449	40.6%
	40-50				90	8.1%
Serum 25 (OH) D-Vitamin		3	-	75	11.1	13.7 \pm 9.2
Serum 25 OH D-Vitamin	0-5				128	11.6%
	5-10				365	33%
	10-20				375	33.9%
	20-30				169	15.3%
	>30				68	6.2%
Month	January				46	4.2%
	Februart				51	4.6%
	March				73	6.6%
	April				77	7%
	May				57	5.2%
	June				135	12.2%
	July				86	7.8%
	August				81	7.3%
	September				124	11.2%
	October				87	7.9%
	November				93	8.4%
	December				195	17.6%
Season	Winter				292	26.4%
	Spring				208	18.8%
	Summer				308	27.9%
	Autumn				297	26.9%

Serum 25(OH)D levels ranged from 3 to 75 ng/mL, with a median value of 11.1 ng/mL and a mean level of 13.7 ± 9.2 ng/mL. The categorized distribution of serum 25(OH)D levels was as follows: 0–5 ng/mL in 11.6% of participants, 5–10 ng/mL in 33.0%, 10–20 ng/mL in 33.9%, 20–30 ng/mL in 15.3%, and >30 ng/mL in 6.2%. Based on these values, vitamin D deficiency (<20 ng/mL) was identified in 78.5% of the study population (Figure 1).

Significant variation in serum 25(OH)D levels was observed across the calendar months. The lowest mean level was recorded in December (11.40 ± 8.46 ng/mL), whereas the highest mean level was observed in August (16.26 ± 9.65 ng/mL). A similar pattern was noted in the median values, with

a decline during the winter months (December: 8.21 ng/mL) and a marked increase during the summer months (August: 14.07 ng/mL) (Table 2).

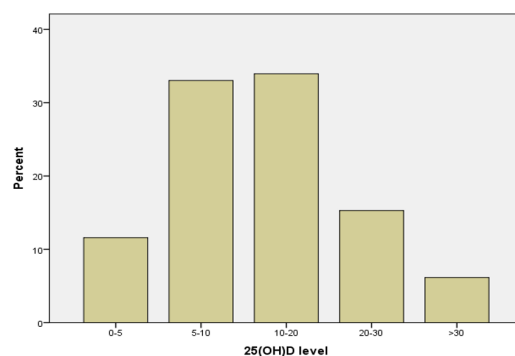


Figure 1. Percentage Distribution of Serum 25(OH)D Levels

Table 2. Monthly Distribution of Serum 25(OH)D Levels

Month	N	Min–Max	Median	Ort ± SD
January	46	3.70 – 41.60	11.05	14.75 ± 9.72
Februart	51	3.00 – 75.00	11.10	15.40 ± 13.18
March	73	3.00 – 39.00	9.71	11.45 ± 7.85
April	77	3.00 – 45.90	11.00	13.14 ± 7.70
May	57	5.29 – 51.60	13.90	16.22 ± 9.58
June	135	3.00 – 42.70	11.50	13.85 ± 8.59
July	86	3.00 – 46.60	11.90	14.54 ± 8.91
August	81	3.00 – 43.80	14.07	16.26 ± 9.65
September	124	3.00 – 65.50	12.80	15.37 ± 9.84
October	87	3.00 – 40.80	11.00	13.07 ± 9.14
November	93	3.00 – 33.60	10.70	13.25 ± 8.14
December	195	3.00 – 45.60	8.21	11.40 ± 8.46
Total	1105	3.00 – 75.00	11.10	13.73 ± 9.19

When evaluated by season, the lowest serum 25(OH)D levels were recorded during winter (median: 9.10 ng/mL; mean: 12.63 ± 9.76 ng/mL). The highest levels were observed in summer (median: 11.95 ng/mL; mean: 14.66 ± 9.08 ng/mL). Spring and autumn also demonstrated higher median and mean vitamin D levels compared with winter, following the upward trend seen in the summer season (Table 3).

Table 3. Seasonal Distribution of Serum 25(OH)D Levels

Season	N	Min–Max	Median	Ort ± SD
Winter	292	3.00 – 75.00	9.10	12.63 ± 9.76
Spring	208	3.00 – 51.60	11.40	13.39 ± 8.46
Summer	308	3.00 – 46.60	11.95	14.66 ± 9.08
Autumn	297	3.00 – 65.50	11.57	14.09 ± 9.12
Total	1105	3.00 – 75.00	11.10	13.73 ± 9.19

In the subgroup analysis based on age, serum vitamin D levels were significantly lower in pregnant women under 30 years of age compared with those aged 30 years and older ($p < 0.001$) (Table 4).

Table 4. Comparison of Serum Vitamin D Levels Between Age Groups (vs. <30 and >30 years)

Age	Serum 25 OH D-Vitamin				p
	Min-Max	Median	Mean±SD		
<30	3.0 - 45.6	9.2	11.5	9.2	<0.001
>30	3.0 - 75	14	16	10.1	

When subgroup analysis was performed according to age, a statistically significant difference was found between the under-30 and over-30 age groups in terms of vitamin D levels ($p < 0.001$). (Table 4). In the Spearman correlation analysis, vitamin D values

showed a statistically significant, weakly positive correlation with increasing age ($\rho=0.282$; $p<0.001$).

When the seasons were grouped as Winter–Spring and Summer–Autumn, a statistically significant difference in serum vitamin D levels was observed between the two groups ($p = 0.001$). Vitamin D levels during the Winter–Spring period were significantly lower compared with those in the Summer–Autumn period (Table 5).

Table 5. Comparison of Serum Vitamin D Levels Between Seasonal Groups (Winter–Spring vs. Summer–Autumn)

Season	Serum 25 OH D-Vitamin			p	
	Min-Max	Median	Mean±SD		
Winter	3.0- 75	10.3	12.9	9.2	<0.001
Spring					
Summer	3.0- 65	11.7	14.4	9.1	
Autumn					

Discussion

Vitamin D plays a crucial role in maternal and neonatal health by regulating calcium and phosphorus homeostasis, supporting skeletal development, and modulating immune function during pregnancy. Adequate maternal vitamin D status is essential not only for maintaining maternal bone health but also for ensuring optimal foetal growth and development. Vitamin D deficiency during pregnancy has been associated with a range of adverse maternal and neonatal outcomes, including impaired fetal skeletal mineralisation and alterations in immune responses. In light of this evidence, current guidelines issued by the Royal

College of Obstetricians and Gynaecologists (RCOG) and the American College of Obstetricians and Gynaecologists (ACOG) recommend daily supplementation with at least 400 IU of vitamin D₃ throughout pregnancy to ensure sufficient maternal and foetal vitamin D levels (7,8).

Large-scale studies conducted in Türkiye have reported a high prevalence of vitamin D deficiency, ranging between 60% and 90%. For instance, Hekimsoy et al. reported a deficiency rate of nearly 93% among adults (9), while similarly, Çidem et al. identified deficiency rates exceeding 70% in young adults (10). Aydın et al. found that approximately 90% of women in the third trimester of pregnancy were vitamin D deficient (11), whereas Demircan et al. reported severe deficiency levels in both mothers and their newborns (12). Comparable findings have also been observed in European countries; in a multicentre study conducted by Lips et al., unexpectedly high rates of vitamin D deficiency were reported even in countries with sunny climates (13). International studies further corroborate these findings. In Qatar, Dawodu et al. demonstrated that more than 80% of pregnant women were vitamin D deficient (14).

In the present study, serum 25-hydroxyvitamin D [25(OH)D] levels were evaluated in 1105 individuals aged between 17 and 50 years, revealing that vitamin D deficiency was highly prevalent in the study population. Serum 25(OH)D levels below 20 ng/mL were observed in 78.5% of participants, indicating that our findings are consistent with both national and international literature. Age-stratified analysis revealed that vitamin D levels were significantly lower in individuals under 30 years of age compared with those aged over 30 years. Correlation analysis further supported this observation, demonstrating a weak but statistically significant positive association between age and serum vitamin D levels. The lower vitamin D levels observed among younger adults may be attributed to lifestyle-related factors, including increased time spent indoors, widespread use of sun-protective measures, clothing preferences that limit sun exposure, and more sedentary behaviors.

Seasonal variation in serum 25-hydroxyvitamin D [25(OH)D] levels is a well-documented finding in the literature. In the present study, the lowest vitamin D levels were observed during the winter months, whereas the highest levels were recorded in the summer, reflecting the pivotal role of sunlight exposure in cutaneous vitamin D synthesis. Similar seasonal fluctuations have been reported in studies conducted across different regions of Türkiye. For example, Erkal et al. demonstrated a marked decline in vitamin D levels during winter and a significant increase during the summer months in their study conducted in Istanbul (15). Consistent findings have also been reported in studies from Canada, Germany, Japan, and Iran, where mean serum 25(OH)D levels during winter were found to be approximately 30–60% lower than those measured in summer (16-19). Therefore, the observed seasonal variability suggests that our findings suggest a universal pattern that is independent of geographical location.

In the analysis where seasons were grouped as winter–spring and summer–autumn, the finding that vitamin D levels were significantly lower during the winter–spring seasons supports seasonal clustering studies in the literature. Studies conducted in Northern European countries have shown that 25(OH)D levels drop to minimal values during the winter–early spring months, defined as the ‘sunless period’. These results indicate that vitamin D supplementation is particularly critical for public health during the winter months.

The retrospective design of this study represents a major limitation. Information regarding participants’ clothing style, sun exposure duration, and vitamin D supplementation prior to blood sampling, all of which may influence serum vitamin D levels were not available. Therefore, these uncontrolled factors may have affected the interpretation of the study results.

Conclusion

The results of this study indicate that vitamin D deficiency is highly prevalent among pregnant women, that age and seasonal factors exert significant effects on serum vitamin D levels, and that high-risk

groups, particularly pregnant women, require closer monitoring. These findings underscore the importance of developing community-based preventive health strategies, promoting appropriate sun exposure behaviors, and implementing targeted vitamin D supplementation programs for at-risk populations.

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None

Conflict of interest statement

The authors of this work have nothing to disclose.

Ethics Committee Approval

Ethical approval for the study was obtained from the Istanbul Kartal Dr. Lütfi Kırdar City Hospital Ethics Committee (dated 24 April 2024, reference no: 2024/010.99/3/6).

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