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Prevalence of Vitamin D Deficiency and Seasonality Effect in First Trimester Pregnant Women Referring to a Tertiary Health Care Institution

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ABSTRACT

Objective: We aim to investigate the prevalence of low vitamin D levels in pregnant women receiving medical care at a tertiary hospital by analyzing the seasonal variations in these levels.

Methods: This study was conducted at the Obstetrics and Gynecology outpatient facility of a tertiary medical institution between February 2020 and February 2024. The demographic data, including maternal age, parity, gestational age, smoking status, vitamin D level, and seasonal information, were duly captured from the first antenatal medical examination records.

Results: After the exclusion of individuals who did not meet the predetermined criteria, a total of 1101 pregnant women were selected to partake in the study. Among the pregnant women, a large proportion (866, 79%) had serum 25(OH)D concentrations lower than 20 ng/mL, with an additional 132 out of 866 (15.2%) having levels below 5 ng/mL. The overall sample group showed a mean vitamin level of 13.71±9.18, while the subset of participants with a vitamin D deficiency had a recorded value of 9.85±4.62. During the fall and summer seasons, a considerable 82% and 72.8% respectively exhibited a significant prevalence of hypovitaminosis D. The trend curve for the seasonal vitamin D levels of the vitamin D-deficient group shows a relatively flat pattern, with an R^2=0.0097 score.

Conclusion: The findings from our investigation corroborate the implementation of prenatal multivitamins enriched with vitamin D as a preventive measure against musculoskeletal and non-musculoskeletal conditions for maternal and neonatal health.

INTRODUCTION

Vitamin D is a fat-soluble steroid that has historically been known for its role in calcium and phosphorus homeostasis and bone maintenance. Additionally, lung, muscle, heart, bone marrow, blood vessels, brain, breast, colon, prostate, thyroid, parathyroid glands, pancreas, gonads, placenta, skin, fat tissue, and activated B- and T-lymphocytes contain vitamin D receptors and activating enzymes (1-alpha-hydroxylase) for synthesizing 1,25-dihydroxy-vitamin D [1,25(OH)2D], which is a precursor of vitamin D. These organs and cells are thought to carry out a local vitamin D function, potentially through autocrine or paracrine pathways.[1,2]

Vitamin D deficiency is a worldwide public health concern affecting all ages, races, and geographic regions. An estimated over one billion people suffer from vitamin D deficiency since dietary nutrients cannot counterbalance the requirements of the body.[3,4] Vitamin D deficiency impairs bone mineralization and causes rickets in children and osteomalacia in adults. Probably depending on the function of vitamin D among the aforementioned organs and cells, several observational studies have shown that vitamin D deficiency or insufficiency is associated with various non-musculoskeletal diseases such as cardiovascular and metabolic diseases, male and female infertility, cancer, autoimmune, and neurological diseases.[5,6]

Likewise, several studies showed pregnant women have a greater risk for hypovitaminosis D.[7] In pregnancy, 18-99% of inadequate 25-hydroxy-vitamin [25(OH)D] levels have been reported in different populations.[8,9] Vitamin D deficiency during pregnancy not only leads to maternal and fetal musculoskeletal problems but also a higher risk of preeclampsia, gestational diabetes, preterm birth, low birth weight, and cesarean sections. These were accused of being results of vitamin D deficiency by observational studies. It is a foregone conclusion when the mother is deficient, the fetus is concluded to be deficient.[10,11] In the same way, however, it is inconsistent yet, suffering from fetal and neonatal vitamin D deficiency can predispose to bronchiolitis, asthma, autism spectrum disorder, attention deficit hyperactivity disorder, multiple sclerosis, and lower cognitive and psychomotor outcomes.[12,13]

In this present article, we aimed to evaluate the prevalence of vitamin D deficiency changes throughout the seasons among pregnant women attending a tertiary care facility. For this purpose, we collected the vitamin D levels of pregnant women on the first antenatal examination and sorted the data into the seasons.

MATERIALS AND METHODS

The study was conducted between February 2020 and February 2024 at the Obstetrics and Gynecology outpatient clinic of a tertiary hospital. The study was descriptive and made retrospectively. The study sample was pregnant women in the first trimester attending their first antenatal examination. Data were extracted from antenatal care records.

Inclusion criteria were pregnancy, a minimum age of 18 years, singleton pregnancies, and current residency of at least six months before the start of pregnancy. The exclusion criteria of the study were multiple pregnancies, age below 18 years, pregnancy more than 14 weeks, known or suspected drug or alcohol abuse, HIV infection, bone disease, lithium therapy, or known conditions of a history of renal or liver disease, and chronic malabsorption syndromes. Multivitamin consumption before pregnancy was not an exclusion criterion.

This study was approved by the local ethics committee (Date: 27.05.2020, Decision No: 2020/514/178/24).

The vitamin D status was evaluated by measuring 25(OH)D concentrations. The reason for selecting 25(OH)D as a biomarker of vitamin D status is because the nature of 25(OH)D reflects vitamin D obtained from both dietary intake and ultraviolet (UV) skin synthesis. Total 25(OH)D was measured using electrochemiluminescence immunoassay.

There is no universally accepted definition of vitamin D deficiency; therefore, the recommendations of the Institute of Medicine (IOM) were followed as a determinant, which vitamin D deficiency was defined as a 25(OH)D concentration of <20 ng/mL (50 nmol/L), while a serum 25(OH)D concentration of ≥20 ng/mL (50 nmol/L) was considered sufficient.[14]

Age, parity, gestational week, smoking status, and the season at the first antenatal examination were recorded. The 25OH(D) measurements were recorded as 'ng/mL'.

All statistical analyses were conducted using IBM® SPSS® software version 24 (IBM SPSS Armonk, NY). Continuous variables were described as the mean with standard deviation, minimum, and maximum, while categorical variables were given as counts with percentages.

RESULTS

After exclusion criteria, a total of 1101 pregnant women remained for the study. 5.8% of the pregnant women were smokers (n=64). The characteristics of the women are summarized in Table 1.

The mean age of the pregnant women on the blood sample day was 29.79±5.97. The mean parity was 1.22±1.07 and 298 (27%) women were nulliparous.

866 (79%) of the pregnant women had lower serum 25(OH)D concentrations of less than 20 ng/mL (Table 2). Among the pregnant women with low serum 25(OH)D

Table 1. The characteristics of the pregnant women

	Mean	Min	Max	SD
Serum 25(OH)D (ng/mL)	13.71	3	75	9.18
Age	29.79	18	47	5.97
Gestational Week	7.35	4	13	1.67
Parity	1.22	0	6	1.07

Min: minimum; Max: maximum, SD: standard deviation.

Table 2. Pregnant women were divided into groups for vitamin D status

Serum 25(OH)D (ng/mL)	N	Mean	Min	Max	SD
≥20	235	27.94	20	75	7.79
<20	866	9.85	3	19.9	4.62

N: count; Min: minimum; Max: maximum, SD: standard deviation.

Table 3. Vitamin D levels throughout the seasons

Serum 25(OH)D (ng/mL)	Fall	Winter	Spring	Summer
≥20	65 (18%)	32 (18.8%)	58 (21.4%)	80 (27.2%)
<20	300 (82%)	138 (81.2%)	213 (78.6%)	215 (72.8%)

Shown as counts, and percentages.

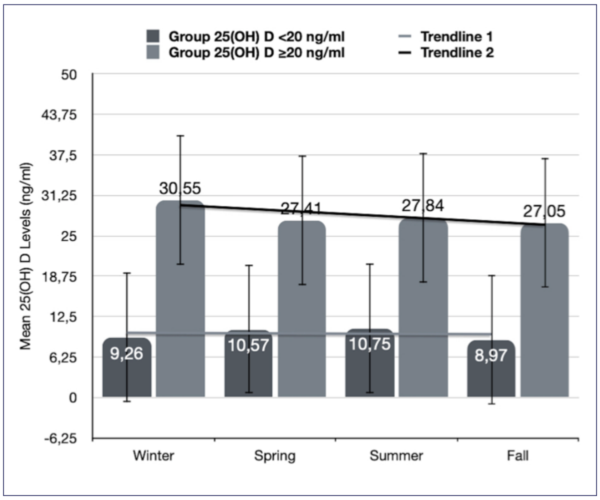

Figure 1. Seasonal variations in the mean serum 25-hydroxyvitamin D concentration.

concentrations, 132 (15.2%) women had less than 5 ng/mL serum 25(OH)D concentrations.

Vitamin D deficiency prevalence in spring and fall was 82% and 72.8%, respectively. Table 3 shows the deficiency prevalence throughout the seasons. Figure 1 demonstrates the trend analysis in mean values in the deficiency and sufficiency group between seasons. Group 25(OH)D <20 ng/mL R2 value of trendline is 0.0097 and Group 25(OH)D ≥20 ng/mL R2

DISCUSSION

In this article, we evaluated the vitamin D levels of pregnant women at their first antenatal visits, and the results were sorted by season. Based on our evaluation, our population has a very high prevalence (79%) of hypovitaminosis D, with a significant number of women (15.2%) suffering from severe vitamin D deficiency (<5 ng/mL).[15] Studies have shown that 18% of pregnant women in the United Kingdom, 25% in the United Arab Emirates, and almost 80% in the Netherlands had vitamin D levels of <25 nmol/L.[8] Another study from Taiwan showed a 99% deficiency in vitamin D with a cutoff point of 30 ng/mL.[9] One possible explanation for the vast differences in prevalence might be attributed to population disparities, such as their dietary intake habits, smoking, sociocultural status, body mass index (BMI), geographic region, sunlight exposure, genetic predisposition, and skin pigmentation. Besides, the high prevalence of vitamin D deficiency cannot be expounded by a single cause. For instance, Hagenau et al. reported that 25(OH)D levels decreased significantly among Caucasians with increasing latitude, whereas there was no change for non-Caucasians.[16] The combination of the reasons mentioned earlier can be the cause of differences between countries and even inter-regions within the same country.

Another possible explanation is that there is no clear consensus on the cutoff point for vitamin D deficiency among pregnant women; therefore, various studies have determined different cutoff points for hypovitaminosis D. On the other hand, investigators around the world suggest that maintaining a circulating 25(OH)D concentration of at least 40 ng/mL before a planned pregnancy or during the earliest time in pregnancy can reduce the risk of vitamin D-related pregnancy complications.[17,18,19,20] It's worth noting that the limit of 40 ng/mL in pregnancy vitamin D physiology is also an important point. The level of 1,25(OH)2D in pregnant blood continues to rise to supraphysiological levels until 25(OH)D has reached 40 ng/mL. The 1,25(OH)2D level remains constant at the same supraphysiological level it reached when the 25(OH)D level is above 40 ng/mL. According to these circumstances, it can be suggested that the 25(OH)D level required for pregnancy should be at least 40 ng/mL.

Depending on the same cutoff point for hypovitaminosis D as in our study, a study from a different region of Turkey evaluated that 90.3% of pregnant women in their last trimester had vitamin D deficiency.[21] Firstly, we can simply point out that even though both articles have studied pregnant women, our study focused on women in the first trimester. So that this variation in prevalence can be attributed to the increasing demand of the fetus for vitamin D as pregnancy progresses, with the mother being the primary source of this essential nutrient.[11] Also, the anticipated increase in weight for pregnant women with a normal BMI is projected to be between 11 and 18 kilograms.[22] Moreover, Tobias et al. showed that BMI was associated with a modified response to vitamin D supplementation and could explain the observed diminished outcomes of supplementation for various health outcomes among individuals with higher BMI. In light of this information, we can interpret that with each passing week of pregnancy, the BMI of the women increases, and even though the pregnant women take multivitamins containing vitamin D, that leads to lower 25(OH)D levels.[23]

Consequently, according to our research, the lowest prevalence of hypovitaminosis D was observed in summer

(72.8%), while the highest prevalence was observed in fall (82%). It is a well-established principle that the skin's reaction to UV radiation is fundamental for vitamin D synthesis. Although our country has four seasons and UV radiation wavelengths change over the year, we determined relatively steady vitamin D deficiency throughout the year. Likewise, Bromage et al. showed that even though the UV radiation changes throughout the year, vitamin D levels stayed almost consistent among pregnant women in Boston.[24] It is reasonable to hypothesize that this pertains to the enduring qualities of the participants, independent of seasonal fluctuations. However, another study from Bangladesh revealed that despite the country having ten hours of daily constant sunlight exposure during the entire year, the researchers observed a high prevalence of vitamin D deficiency.[25] Various studies have demonstrated a high occurrence of vitamin D deficiency in tropical countries, although these areas receive plenty of sunlight and have access to dietary sources of vitamin D (such as fatty fish and vegetables).[26] Adequate sun exposure is essential for the synthesis of vitamin D, as well as many other factors. Therefore, a meticulous examination before the treatment of vitamin D deficiency might be a more adequate and longstanding strategy.

To conclude, our study has two main limitations that must be acknowledged. We did not include information about the dietary and sunbathing habits and BMI of the pregnant women, which can predominantly be considered as the main determinants of vitamin D levels. The second limitation is that, as part of our national health strategy, we started vitamin D supplementation during the second trimester, but we did not monitor the treatment outcomes of all patients during the third trimester. However, our primary objective for this article was to evaluate the prevalence of vitamin D deficiency among our population and see the seasonality of hypovitaminosis D.

Despite these limitations, our study still holds validity. The importance of this work underlies in its extensive research, which involved multiple observations of different seasons over an extended period. The report presented significant data on the prevalence of vitamin D deficiency within a sizable patient population, providing valuable insights for our practice.

Conclusion

Vitamin D has a significant role in fertility, pregnancy, and neonatal outcomes. A public health problem arises from vitamin D deficiency and related illnesses caused by it. We evaluated a high prevalence of vitamin D deficiency among pregnant women. Determining hypovitaminosis D during pregnancy is easy and feasible. Vitamin D deficiency treatment is cheap, safe, and effective. Our study supports the importance of prenatal use of multivitamins containing vitamin D to prevent mothers and neonates from musculoskeletal and non-musculoskeletal diseases caused by hypovitaminosis D. Additional studies are necessary to identify what dose of vitamin D is optimal and when is the best time to start supplementation for pregnancy.

Ethics Committee Approval

This study approved by the Kartal Dr Lütfi Kırdar City Hospital Ethics Committee (Date: 27.05.2020, Decision No: 2020/514/178/24).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: K.T., B.K.; Design: K.T., B.K.; Supervision: K.T., B.K.; Data: B.K.; Analysis: B.K.; Literature search: B.K.; Writing: B.K.; Critical revision: K.T.

Conflict of Interest

None declared.

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Üçüncü Basamak Sağlık Kuruluşuna Başvuran İlk Trimesterdeki Gebe Kadınların D Vitamini Eksikliği Prevalansı ve Mevsimsellik Etkisi

Amaç: Üçüncü basamak bir hastanede tıbbi bakım alan gebe kadınlarda düşük D vitamini düzeylerinin prevalansını ve bu seviyelerdeki mevsimsel değişimleri analiz ederek değerlendirmeyi amaçladık.

Gereç ve Yöntem: Bu çalışma, Şubat 2020 ile Şubat 2024 tarihleri arasında üçüncü basamak bir tıp kuruluşunun Kadın Hastalıkları ve Doğum polikliniğinde yürütüldü. İlk antenatal kontrol sırasında yaş, parite, gestasyonel hafta, sigara kullanımı bilgisi, D vitamini seviyesi ve mevsim bilgisi kayıt altına alındı.

Bulgular: Çalışmamıza 1101 gebe dahil edildi. Bu gebe kadınların 866'ında (%79) D vitamini eksikliği tespit edilirken, 866 gebenin 132'sinde D vitamini seviyesi 5 ng/ml'nin altında tespit edildi. Toplam çalışma grubunda vitamin D değeri ortalaması 13.71+/-9.18 iken, vitamin D eksikliği olan grupta 9.85+/-4.62 idi. Yaz ve sonbahar aylarındaki hipovitaminozis D prevalansı ise sırasıyla %72.8 ve %82 olarak tespit edildi. D vitamini eksikliği olan grubun mevsimsel D vitamini seviyelerinin ortalamasının eğilim eğrisi $R2=0.0097$ değeriyle rölatif olarak sabit kalmaktadır.

Sonuç: Araştırmamızdan elde edilen bulgular, anne ve yenidoğan kas-iskelet sistemi ve kas-iskelet sistemi dışı sağlığı için D vitamini ile zenginleştirilmiş doğum öncesi multivitaminlerin uygulanmasını desteklemektedir.

Anahtar Sözcükler: D vitamini; gebelik; hipovitaminozis D; mevsimsellik; prevalans.