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Original Article

Evaluation of seasonal variation of vitamin D levels according to demographic criteria

Soycan Mizrak, Ali Volkan Ozdemir

Usak Training And Research Hospıtal, Medical Biochemistry Laboratory, Usak, Turkey

Abstract

Aim: Although vitamin D can be taken with nutrients, it is substantially synthesized in the skin tissue under the influence of the ultraviolet ray which comes from the sunlight. Therefore, the increase in the expression of vitamin D in the body during periods of increased sunlight can be expected. In this study, it was aimed to determine whether the change in the serum vitamin D levels of the patients who applied to Uşak Training and Research Hospital were significant according to age, gender and months of the year.

Material and Methods: The serum vitamin D test results of the patients aged 0-80 who applied to the outpatient clinics of the hospital between 1 January and 31 December 2018 were retrospectively obtained from the hospital automation system. Data were analyzed using SPSS 21 software. $p<0.05$ was considered significant.

Results: The largest population of 62.253 vitamin D requests is 18-65 age groups. Serum vitamin D levels were found to be 16.18±10.39 ng/ml in the whole population: 15.85±10.49 ng/ml in women and 17.18±10.03 ng/ml in men. The mean value for women was statistically lower than men ($p <0.05$). There was a statistically significant difference between vitamin D averages in months, the lowest mean value in January (10.74±8.58 ng / ml), the highest value in July (23.29 ±10.6 ng / ml).

Conclusion: In this study, the mean levels of vitamin D were found to be insufficient even in the summer months when sunlight was the most effective. This may be due to the fact that the population may benefit from less sunlight or structural variations of the vitamin D-binding proteins in the body may affect the use of vitamin D. Therefore, extensive research is needed to determine the level of clinical effects of vitamin D deficiency.

Keywords: Adult age; sun light; Vitamin D

INTRODUCTION

Rickets disease spread with the industrial revolution. Scientists have done many types of research to prevent and treat this disease and emphasized the importance of vitamin D. Vitamin D is a fat-soluble vitamin. It differentiated from other vitamins due to its endogenous synthesis in the body. Vitamin D is also considered a hormone. One of the reasons is that its structural similarity with steroid hormones, the other is that its active form plays a role in calcium-phosphorus metabolism and regulation of genomic functions (1).

Vitamin D endogenously synthesized from 7 dehydrocholesterol, the intermediate metabolite in cholesterol synthesis. Cholecalciferol (vitamin D3) occurs in the dermis and epidermis by exposure to sunlight from 7-dehydrocholesterol. The human body takes from diet or supplements is ergocalciferol (vitamin D2). Vitamin D3 transported to target organs by binding to vitamin D binding proteins (DBP), while vitamin D2 transported in chylomicrons. Vitamin D hydroxylated by the 25-hydroxylase enzyme in the liver and 25-hydroxyvitamin D (25-OHD) formed. In the proximal tubules mitochondria of the kidneys, advanced hydroxylation of 25-OHD to 1,25-dihydroxyvitamin D (1,25-OHD) occurs. 1,25-OHD is the physiologically active form of vitamin D. (2). However, we used 25-OHD form when analyzing vitamin D. Because the amount of 25-OHD in serum is greater and has a longer half-life than 1,25-OHD (3). Vitamin D deficiency is common in our country and the world. ıt is the fact that we cannot benefit from sunlight because of various reasons. The reference ranges used in the interpretation of vitamin d deficiency determined by the Endocrine Community. (4). Vitamin D deficiency described as an epidemic worldwide. So how appropriate are we doing vitamin D test requests?, Does the vitamin D form we analyze reflect the actual condition in the body or do we interpret the results indirectly?, How accurate are the cut-off values used when interpreting the vitamin D results? Since every vitamin D level below the cut off values we

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Corresponding Author: Soycan Mizrak, Usak Training And Research Hospıtal, Medical Biochemistry Laboratory, Usak, Turkey
E-mail: soycan 35@hotmail.com

use, does not cause a clinical pathological condition, do we need different indexes or different forms of the vitamin when interpreting the vitamin D test result? Within the framework of these questions, we will discuss the causes of vitamin D deficiency by looking at the difference between 25-hydroxy vitamin D (25-OHD) levels according to age, gender and seasons of the year in this study.

MATERIAL and METHODS

The present study was a retrospective study. The Ethical Committee and Institutional Review Board of Usak University Faculty of Medicine, where the study was conducted, approved the study design. In this study, vitamin D tests which were requested and analyzed between January and December 2018, were evaluated retrospectively. Data were obtained from Hospital Laboratory Information Communication System. Age, gender and vitamin D levels of the patients were divided into groups according to months. The patients were grouped as 0-1 years, 1-17 years, 18-65 years and over 65 years. For each age group, patients were separated according to vitamin D levels for 12 months; Group 1 (<10 ng/mL), Group 2 (10-20 ng/mL), Group 3 (20-29 ng/mL) and Group 4 (> 30 ng/mL). Patients with vitamin D levels above 80 ng/mL were excluded. Vitamin D level was measured by chemiluminescence immunoassay method (Centaur XP, Siemens). Data were analyzed using SPSS 21 software program. Parametric One Way ANOVA test was used for the analysis, p <0.05 was considered significant.

RESULTS

The 18-65 age group constitutes for the largest proportion of the population requested (%71) and tested for vitamin D (Table 1). Of the 62.253 people included in the study, 44.276 were women and 17.977 were men (Table 2).

Table 1. Age groups histogram and their frequencies according to the total group

	Frequency	Percent	Valid Percent	Cumulative Percent
Age 0-1	1542	2.5	2.5	2.5
Age 2-17	6052	9.7	9.7	12.2
Age 18-65	43867	70.5	70.5	82.7
Age >65	10792	17.3	17.3	100.0
Total	62253	100.0	100.0	

The mean serum vitamin D was 16.18±10.39 ng/ml in the whole population, while it was calculated as 15.85±10.49 ng/ml in women and 17.18±10.03 ng/ml in men. Mean value was significantly lower in women than men (p <0.05). While 70% of the population over 2 years of age has values below 20 ng/mL, vitamin D levels are usually above 20ng/mL in the 0-1 age group (Table 3). According to age groups, mean vitamin D levels were highest in the 0-1 age group (25.2±12.4 ng/mL) and lowest in the 18-65 age group (16.1±10.3 ng/mL) (Table-4).

Table 2. Gender distribution in the group for which vitamin D test is requested

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Men	17977	28.9	28.9	28.9
Women	44276	71.1	71.1	100.0
Total	62253	100.0	100.0	

Table 3. Mean results and frequencies of the study groups

Result Group	Age Group				Total
	Age 0-1	Age 2-17	Age 18-65	Age >65	
<10 ng/mL	141	1777	14102	3212	**19232**
10-20 ng/mL	405	2340	17275	3974	**23994**
20-30 ng/mL	530	1380	8514	2309	**12733**
30-80 ng/mL	466	555	3976	1297	**6294**
	1542	6052	43867	10792	**62253**

Table 4. Mean Vitamin D results of the Age Groups

Age Group	N	Mean (ng/mL)	SD
0-1	1542	25.2	12.4
2-17	6052	16.8	10.2
18-65	43867	16.1	10.3
Over 65	10792	17.4	11.1
Total	62253	16.7	10.6

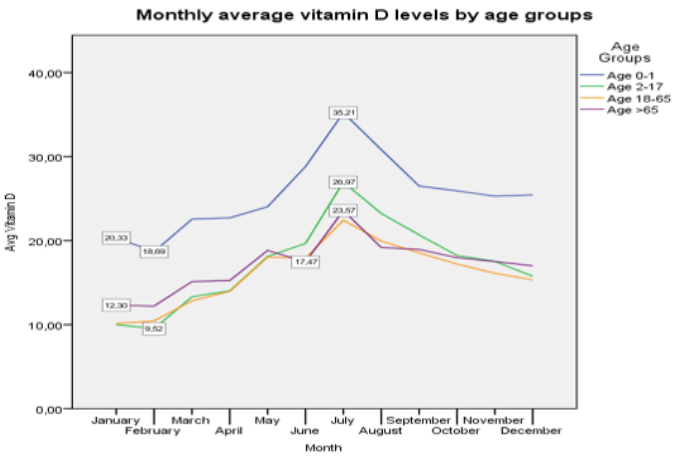

Figure 1. Monthly average vitamin D levels by age groups

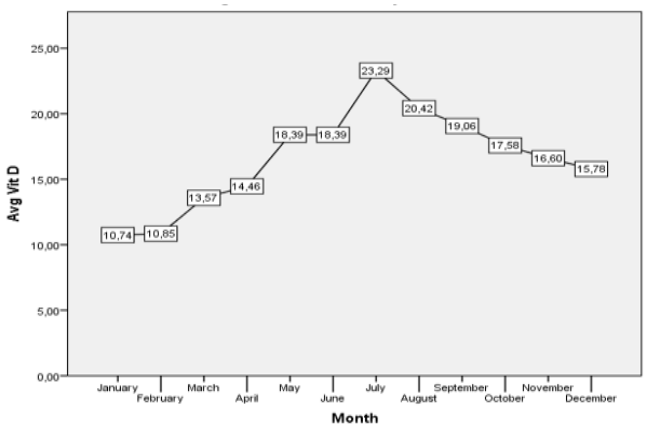

Figure 2. Average Vitamin D Levels by Months

ANOVA was used to analyze whether changes in mean vitamin D values by months were significant. Accordingly, the highest average vitamin D levels in the 0-2 age group; the lowest vitamin D levels were seen in the 18 and older age groups (Figure 1). There was a statistically significant difference between the mean values of vitamin D according to months ($p < 0.05$), the lowest mean values in January (10.74 ± 8.58 ng/ml), the highest mean values in July (23.29 ± 10.6 ng/mL) (Figure 2).

When the distribution of patients grouped according to vitamin D test levels is examined according to months, advanced insufficient vitamin D levels, which are <10 ng / mL, decrease to the lowest percentages (8%) in June and July when the sun rays come at a more steep angle, and draw a plateau rising towards the winter season (69%) (Figure 3).

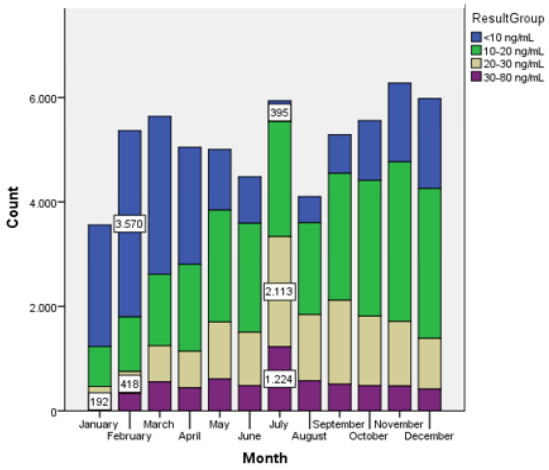

Figure 3. Distribution of result groups by months

DISCUSSION

In this study, the average vitamin d levels found to be low even in the summer when sunlight was most intense. This may be due to benefit insufficiently from sunlight or structural variations of vitamin D binding proteins (VDBP). In the bloodstream, 85% of the 25-OHD vitamin bound to VDBP, 10-15% bound to albumin, and 1-2% freely circulated (5). 25-OHD transported with VDBP to the kidneys. It converts to the active form of vitamin D, is named 1,25-OHD (1). Common genetic polymorphisms in the VDBP gene appear to inhibit some of the effects of vitamin D because the bound fraction is not effective on the target cells. The prevalence of these polymorphisms varies among races. Biochemical analyzes measure a total level of 25-OHD without distinguishing fractions bound to carrier proteins (6).

The fact that the 0-2 age group has vitamin D levels closer to the average may be due to the vitamin D preparations used in that period. As shown in graphic-3, it should note that in July, when sunlight is the most intense and the angle is steep, vitamin D adequacy expressed as 30 ng / mL and above determined as a maximum 17%. These results raise the question of why we cannot reach adequate vitamin D levels.

As the angle of the sun becomes more oblique, the path length increases, ozone is allowed to absorb UVB radiation more, thus reducing the amount reaching the surface of the earth. Therefore vitamin d didn't synthesize in the skin in the same amount before 09.00 and after 15.00. Melanin and sunscreens effectively absorb UVB radiation, reducing the sun's effectiveness in producing vitamin D on the skin (7).

Another problem is how appropriate vitamin D testing requests are. Vitamin D test generally used as a screening test in all age groups. Elevated levels of PTH, rickets, osteomalacia, osteoporosis, elderly, pregnant and nursing women, obese children, hyperparathyroidism, sarcoidosis, lymphoma, chronic renal failure, obesity, and drug use may directly affect the results (8). Besides, it is still unclear to request a vitamin D test from people without clinical findings or in the risk group.

In this study, as in many studies, vitamin D levels were low, 69% of the study group was below 20 ng/mL. However, the clinical significance of this decrease is related to the bioavailability of vitamin D. The study conducted between white Americans and black Americans, provided a different perspective for the evaluation of vitamin d levels. Although the vitamin D level was lacking in black Americans, they had higher bone quality than White Americans. It suggested the importance of vitamin d bioavailability and genetic polymorphism in vitamin d binding protein shown to be effective (9). There should be different limits according to age-gender-race-seasons instead of using the same reference range for whole population. Accordingly, the calculation of vitamin d bioavailability by analyzing free 25-OHD levels instead of total 25-OHD levels would be more accurate to diagnose vitamin d deficiency. Because due to the presence of VDBP polymorphism, low levels of total 25-OHD alone are not enough to cause clinical problems. Further research is needed on these issues.

CONCLUSION

In conclusion, vitamin D levels are widely low in our country as in the whole world. The ineffective and insufficient use of sunlight has a large share in this condition. However, when interpreting the vitamin D test result, attention should be paid to the presence of clinical complaints and demographic characteristics of the patients. Besides, the use of bioavailability calculation instead of the total level of vitamin D would be more appropriate in the approach to the concept of vitamin deficiency.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: The Ethical Committee and Institutional Review Board of Usak University Faculty of Medicine, where the study was conducted, approved the study design.

Soycan Mizrak ORCID: 0000-0003-0287-9402

Ali Volkan Ozdemir ORCID: 0000-0002-9637-6525

REFERENCES

1. Holick MF. The Vitamine D Deficiency Pandemic: a Forgotten Hormone Important for Health. Public Health Reviews 32;267-83.
2. Cashman KD, Heuvel E, Schoemaker R, et al. 25-Hydroxyvitamine D as a Biomarker of Vitamine D Status and Its Modeling to Inform Strategies for Prevention of Vitamine D Deficiency within the Population. Adv Nutr 2017;8:947-57.
3. Holick MF. Vitamine D status: measurement, interpretation and clinical application. Ann Epidemiol 2009;19:73-8
4. HolickMF, Binkley NC, Bischoff-Ferrari HA, et al. Evaluation, treatment and prevention of vitamine D deficiency: an Endocrine Society clinical practice guideline. J Clin Endocrinol Metab 2011;96:1911-30.
5. Jemielita TO, Leonard MB, Baker J, et al. Association of 25-hydroxyvitamine D with areal and volumetric measures of bone mineral density and parathyroid hormone: impact of vitamine D-binding protein and its assays. Osteoporos Int 2016;27:617-26.
6. Evans MK, Lepkowski JM, Powe NR, et al. Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS): overcoming barriers to implementing a longitudinal, epidemiologic, urban study of health, race, and socioeconomic status. Ethn Dis 2010;20:267-75.
7. Holick MF. Biological effects of sunlight, ultraviolet radiation, visible light, infrared, and vitamine D for health. Anticancer 2016;36:1345-56.
8. Reid IR, Holick MF, Thadhani R, et al. Vitamine D: The More We Know, the Less We Know. Clinical Chemistry 2015;61:462-5.
9. Powe CE, Evans MK, Wenger J, et al. Vitamine D–Binding Protein and Vitamine D Status of Black Americans and White Americans. N.Engl.J.Med 2013;21:369.