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Research Article

EVALUATION OF SERUM VITAMIN D LEVELS ACCORDING TO SEASON, AGE, AND GENDER IN MARDIN PROVINCE AND ITS SURROUNDINGS

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Abstract: *Vitamin D is a steroid in character and fat-soluble vitamin. It is produced primarily from cholesterol in the skin and is also taken up in a small amount in the diet. 25(OH)D_3 levels are used as an indirect measure of vitamin D levels. Our aim was to investigate the variation in serum 25(OH)D_3 levels of patients admitted to the hospital in and around Mardin based on gender, season, and age. 25(OH)D_3 concentrations were evaluated at Mardin Training and Research Hospital between 01.01.2017 and 31.12.2019. Our study established subgroups according to gender, season, age, and 25(OH)D_3 status. 25(OH)D_3 concentration was measured using the chemiluminescence method. A significant decrease was observed in the 25(OH)D_3 levels of female (13.62±11.53 ng/ml) patients compared to male patients (12.14±9.38 ng/ml). A significant increase was detected in the summer and autumn seasons compared to winter and spring ($p<0.001$). There was no significant difference between age and serum 25(OH)D_3 concentration ($p>0.05$). 25(OH)D_3 status was shown to be 60.5% in the severe deficiency group. As a result, it has been shown that the vitamin D profile in Mardin and its surroundings is low in all seasons and in all age groups. For this reason, consuming food sources rich in vitamin D and taking supplements indicate that the importance of sunlight in vitamin D metabolism should be emphasized.*

Keywords: *Vitamin D, Gender, Age, Seasons, Sunlight*

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1. Introduction

Vitamin D is known to have important functions in maintaining bone health by regulating calcium and phosphorus metabolism [1]. In epidemiological studies, it has been stated that it is associated with diabetes mellitus, cardiovascular diseases, cancer, multiple sclerosis, autoimmune diseases, and psychiatric and infectious diseases [2-6]. It has also been reported to be associated with the pathophysiology of Parkinson's disease [7]. In autoimmune diseases and multiple cancers, vitamin D stimulates apoptosis and sensitizes cells to chemotherapy by reducing angiogenesis [8]. Vitamin D levels are used as a measure of 25(OH)D_3 levels in patients. Serum levels of 25(OH)D_3 are classified as adequate, insufficient, and deficient [9].

There are two forms of vitamin D: vitamin D_2 in plants and vitamin D_3 in animals [10]. The difference between vitamins D_2 and D_3, which act as prohormones, lies in the structure of their side chains; theoretically, they are used by the body in the same way [11]. Vitamins D_2 and D_3 are biologically inactive. 7-dehydrocholesterol, an intermediate product of cholesterol from epidermal cells in the skin, turns into pre-vitamin D_3 molecules as a result of exposure to sunlight. Vitamin D, taken from the outside, is activated by two hydroxylation mechanisms. The first mechanism takes place in the liver and forms 25(OH)D_3. This variant of vitamin D makes up the majority of circulating storage forms. The half-life of this molecule is approximately 2–3 weeks. A second hydroxylation reaction occurs in the kidneys, and with this conversion, 1,25$(OH)_2D_3$ is formed. The half-life of calcitriol is approximately 4–6 hours [12-14].

This study aims to investigate the variation of 25(OH)D_3 levels between gender, season, and age in patients admitted to the hospital in and around Mardin province.

2. Materials and methods

The vitamin D results of patients who applied to Mardin Training and Research Hospital between 01.01.2017-31.12.2019 were evaluated. Chronic renal failure, hypertension, diabetes mellitus, vitamin D supplementation, acute and chronic inflammation, and thyroid dysfunction were determined as exclusion criteria. The study was approved with the permission of the scientific researchers and Publication Ethics Committee of Mardin Artuklu University (11.08.2021 issue no: 7/6). A total of 3,679 patients (female = 2,865: male = 814) were included in our study and grouped according to age, gender, season, and vitamin D status. 25(OH)D_3 concentrations were classified according to the season: spring, summer, autumn, or winter. In terms of age, they were divided into three subgroups: 18–39 years, 40–69 years, and 70 years. They were then further categorised into four groups for the evaluation of vitamin D status: the I-Severe deficiency group, II-Deficiency group, III-Insufficiency group, and IV-Normal group [15]. Serum 25(OH)D3 levels were determined with the ADVIA Centaur XP brand device using the chemiluminescence method.

2.1. Statistical analysis

Statistical analysis was performed using the SPSS (v. 23) program. The compatibility of the data with the normal distribution was checked with the Kolmogorov - Smirnov test and visual graphics. Since the data were not normally distributed, Mann Whitney-U was used to compare paired groups, and Kruskal Wallis Test was used to compare more than two groups. In the comparison with the Kruskal-Wallis Test, 2-comparisons were made with the Mann-Whitney-U test by making Bonferroni correction in order to understand from which group the statistical difference originated. In all statistical analyzes, those with a p-value below 5% were statistically significant.

3. Results

Descriptive statistics, mean, and standard deviation values are given in the tables. The demographic data of the patients and the mean 25(OH)D_3 level are given in Table 1. It has been demonstrated that the mean 25(OH)D_3 level in female patients (12.14± 9.38 ng/ml) was lower than in male patients (13.62 ± 11.53 ng/ml) and was statistically significant. ($p<0.001$). Table 1

Regarding the seasons, 25(OH)D_3 levels were 10.82 ± 8.31 ng/ml in spring, 13.66 ± 9.90 ng/ml in summer, 15.04 ± 11.41 ng/ml in autumn, and 10.58 ± 9.16 ng/ml in winter. It was determined that the summer and autumn seasons were higher than the winter and spring seasons and were statistically significant ($p<0.001$). Table 2

25(OH)D_3 concentration by age was 12.54 ± 10.92 ng/ml in patients aged 18–39 and 12.16 ± 8.64 ng/ml aged 40–69 years, respectively, and in patients aged 18–39 years and above 13.32 ± 9.30 ng/ml. No statistically significant difference was found between age and 25(OH)D_3 concentration. ($p>0.05$). When analysing 25(OH)D_3 status, 60.5% (n=2.224) of the severe deficiency group, 25.5% (n=939) of the deficiency group, 10.4% (n=383) of the inadequacy group, and 3.6% of the normal group (n=133) were observed. Table 3

While the 25(OH)D3 concentration was observed as the lowest month with a 9.45±8.20 ng/ml level in February, October was observed to be the highest month with 18.11 ± 10.83 ng/ml. Table 4

Table 1. Serum 25(OH)D_3 (ng/ml) levels according to gender

Gender	n	(%)	(M±SD)	*p*
Female	2865	(77,9)	12,14± 9,38	0,000
Male	814	(22,1)	13,62 ± 11,53	

M:Mean SD; standard deviation *=p<*0.001*

Table 2. Serum 25(OH)D_3 (ng/ml) levels according to seasons

Seasons	n	%	(M±SD)		*P*
Spring	924	(25,1)	10,82±8.31	Group 1-3	
Summer	888	(24,1)	13,66±9,90	Group 1-2 Group 2-3	
Autumn	894	(24,3)	15,04±11,41	Group 2-4	0,000
Winter	973	(26,4)	10,58±9,16	Group 3-4 Group 1-4	

Mean:Mean SD; standard deviation *=p<0.001 Group 1; Spring, Group 2; Summer, Group 3; Autumn, Group 4; Winter

Table 3. Distribution of 25(OH)D_3 (ng/ml) levels by status and age groups

Status		n	(%)		
Severe deficiency group	<11	2224	(60,5)		
Deficiency group	11-20	939	(25,5)		
Inadequacy group	21-30	383	(10,4)		
Normal group	>30	133	(3,6)		
Age		**n**	**(%)**	**(M.±SD)**	***p***
18-39 age		1842	(50,1)	12,54±10,92	0,109
40-69 age		1452	(39,5)	12,16±8,64	
70 age		385	(10,5)	13,32±9,30	

M: Mean SD; standard deviation

Notes: Severe deficiency group (vitamin D level <11 ng/ml), II- Deficiency group (vitamin D level 11-20 ng/ml), III- Insufficiency group (vitamin D level 21-30 ng/ml) IV- normal group (with vitamin D level >30 ng/ml)

Table 4. Serum 25(OH)D_3 (ng/ml) level by month

Month	n	(%)	(M±SD)
January	300	(8,2)	10,79±9,21
February	380	(10,3)	9,45±8,20
March	300	(8,2)	11,09±10,32
April	299	(8,1)	10,31±6,51
May	325	(8,8)	11,04±7,69
June	275	(7,5)	14,44±8,45
July	301	(8,2)	13,07±11,91
August	312	(8,5)	13,55±8,88
September	281	(7,6)	14,65±13,60
October	246	(6,7)	18,11±10,83
November	366	(9,9)	13,30±9,39
December	294	(8,0)	11,83±10,08

M: Mean SD; standard deviation

4. Discussion

Vitamin D is a fat-soluble vitamin with a steroid character that plays a role in calcium homeostasis and bone mineralization. This vitamin is synthesized primarily from cholesterol in the skin and is also taken up in the diet at a low rate [16-18].

The findings of the present study revealed that the mean serum 25(OH)D_3 level (13.62 ± 11.53 ng/ml) in male patients was higher than that in female patients (12.14 ± 9.38 ng/ml). It was determined that there was a significant increase in the summer and autumn seasons compared to the winter and spring. There was no significant difference between age and serum 25(OH)D_3 concentration. 25(OH)D_3 status was shown to be 60.5% in the severe deficiency group. This study is the first to evaluate the differences in 25(OH)D_3 levels between age, gender, and seasons in and around Mardin province

Bolland et al. [19] stated that 25(OH)D_3 deficiency was present at a rate of 39% in men and 73% in women in a study conducted in 1,606 postmenopausal women and 378 elderly men. A study conducted by Vuceljic et al. [20] in Serbia found that the rate of 25(OH)D_3 deficiency in the winter season was higher than in the summer season, and the difference between them was significant in their study in the post-menopausal period. Van der Wielen et al., [21] in their study on 25(OH)D_3 levels in 824 elderly individuals during the winter season, reported that the deficiency was 47% in women and 36% in men.

In a study by Alayunt et al., in Siirt province, 25(OH)D_3 (19.20 ± 0.11 ng/ml) was higher in male patients than in female patients (15.96 ± 0.08 ng/ml) [22]. Taskiran et al. [23] In a study conducted with a 25(OH)D_3 cut-off value of 20 ng/ml, its deficiency was found to be 94.00%. In addition, this level was shown to be 9.6 ± 5.2 ng/ml in female patients and 14.6 ± 5.4 ng/ml in male patients [23]. Cubukcu et al. [24] demonstrated that 25(OH)D_3 concentration was 16.51 ± 11.04 ng/ml in female patients and 16.88 ± 10.19 ng/ml in male patients, and there was a significant difference between male and female patients in terms of season and age. In a study conducted in Elazig only in winter, it was found that the mean 25(OH)D_3 level was 16.81 ± 10.29 ng/ml in men and 14.61 ±1 3.43 ng/ml in women. The rate of vitamin D (<20 ng/m25(OH)D_3), which was investigated as insufficient, was reported to be 73% in men and 78% in women [25].

In our study, 25(OH)D_3 concentration was found to be lower in female patients than in male patients. The results we obtained showed that they were compatible with the studies performed [22, 23]. The present study also revealed that a low level of vitamin D in women suggests that it is probably due to bone mineralization and local clothing.

Although the rate of sun exposure is higher in countries such as Italy, Spain, and Greece, it has been determined that vitamin D deficiency is lower than in Scandinavian countries. These authors also suggested that this level may be caused by excessive fish consumption and vitamin D supplementation. [25]. The fact that the average annual sunshine duration in Mardin is more than 3,000 hours and that the duration of sunshine is 8–9 hours throughout the year [26] has high potential in terms of endogenous synthesis of vitamin D. Another important result we evaluated in our study was the severe deficiency group, which was found to be 60.5%. The fact that this result is so high indicates that people do not go out in the sun during hot hours and that they are not aware that vitamin D can be synthesised endogenously.

In the study conducted in Van, no difference was found between age and 25(OH)D_3 concentration. Güzel et al., in their study conducted in Adana province in August and September in women with covered hands and faces, 25(OH)D_3 levels were reported to be 33.1 ng/ml 25(OH)D_3 in women with a deficit of 53.9 25(OH)D_3 ng/ml. In addition, it was stated that the summer season was significantly higher than the autumn and spring seasons in terms of seasonality [27]. Alayunt et al. [27]. showed that 25(OH)D_3 levels were lower in winter and spring than in summer and autumn, but vitamin D levels were low in all four seasons. In a study conducted by Çolak et al., they reported that 25(OH)D_3 levels are close to each other in winter and autumn and that these values are higher in the spring and summer months [28].

In our study, it was shown that 25(OH)D_3 concentrations in the winter and spring seasons were significantly lower than in the autumn and summer seasons. 25(OH)D_3 concentration was observed with the lowest month in February, while October was observed to be the highest month in this respect. Alayunt et al. also found the highest value in terms of vitamin D in July and October. In our study, the fact that the amount of sunbathing time in the winter is less and the time spent inside the house is high suggests that a sedentary lifestyle may cause a deficiency in vitamin D metabolism.

Balahoroglu et al. [29] 25(OH)D_3 levels were 15.15 ± 9.01 ng/ml in the 18–39 age group, 15.7 ± 9.32 ng/ml in the 40–65 age group, and 16.25 ± 10.26 ng/ml in the 66 age group. In our study, 25(OH)D_3 levels were 12.54 ± 10.92 ng/ml in the 18–39 age group, 12.16 ± 8.64 ng/ml in the 40–69 age group, and 13.32 ± 9.30 ng/ml in the 70-age group. It was shown that there was a serious vitamin D deficiency when compared with the studies of other authors.

5. Conclusion

As a result, it has been shown that 25(OH)D3 levels in female patients in Mardin province and its surroundings are lower than in male patients, and the prevalence of vitamin D deficiency is high in all seasons and in all age groups. In light of these findings, we think that in order to eliminate vitamin D deficiency, which plays an important role in the pathophysiology of diseases, consuming food sources rich in vitamin D and taking supplements and the importance of sunlight on vitamin D metabolism should be emphasized.

Ethical statement

The study was approved with the permission of the scientific researchers and Publication Ethics Committee of Mardin Artuklu University (11.08.2021 issue no: 7/6).

Conflict of interest: The author declares no conflict of interest.

Authors' Contributions

A. D: Conceptualization, Formal analysis, Funding acquisition, Investigation, Project administration, Supervision, Writing – review, and editing. The author reads and approved the final manuscript.

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