Journal of Orthopedics Research and Rehabilitation

Original Article

DOI: 10.51271/JORR-0022

Prevalence of vitamin D deficiency and insufficiency in adults in Ankara province

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Received: 01/01/2024 ◆ **Accepted**: 23/01/2024 ◆ **Published**: 29/01/2024

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ABSTRACT

Aims: Vitamin D deficiency is a prevalent health issue globally. Outpatient clinics frequently encounter complaints related to vitamin D deficiency in adults. This study aims to determine the prevalence of 25(OH) vitamin D deficiency in patients over 18 years old and to investigate potential differences in 25-OH D levels based on age, gender, and seasonal factors.

Methods: This cross-sectional study included 12,740 patients (9,550 females, 3,190 males) with a mean age of 45 years (ranging from 18 to 99 years) attending the Orthopaedics and Traumatology outpatient clinic and Internal Medicine outpatient clinic. The serum 25(OH) Vit D was measured using the ELISA method. The patients were divided into three groups: 1) patients with vitamin D deficiency (<20 ng/mL), 2) patients with insufficient vitamin D levels (21-29 ng/mL), and 3) patients with normal vitamin D values (>30 ng/mL). Binary logistic regression analysis was used to analyse the risk factors for vitamin D deficiency.

Results: The study found that 68.6% of the participants had a vitamin D deficiency, while 21.2% had a vitamin D insufficiency. Binary logistic regression analysis revealed that low levels of 25(OH) Vitamin D were associated with age, gender, and the spring season.

Conclusion: This study suggests that patients with related complaints or findings at outpatient clinic visits should be evaluated for vitamin D deficiency or insufficiency. If diagnosed, dietary support and vitamin D supplementation may be appropriate for those in high-risk groups.

Keywords: 25-hydroxy vitamin D, vitamin D deficiency, D vitamin insufficiency, age, gender, season

INTRODUCTION

Vitamin D deficiency is a prevalent global health issue, affecting a significant proportion of individuals across all age groups and geographical regions. It is important to note that this condition is often asymptomatic and can lead to various health complications if left untreated. Vitamin D deficiency is a prevalent global health issue, affecting a significant proportion of individuals across all age groups and geographical regions. Inadequate dietary supplementation, limited exposure to sunlight, and low calcium intake can all contribute to this consequence.[1] Inadequate levels of vitamin D have been associated with a range of factors, including elderly age, female gender, high latitudes, winter season, dark skin colour, limited sunlight exposure, dietary intake deficiency, malabsorption syndromes, indoor environment and clothing style.[2-4] Although the optimal level of vitamin D is uncertain, numerous studies have shown that vitamin D deficiency is common worldwide, especially in winter.[5,6]

Vitamin D plays an important role in maintaining calcium homeostasis and bone metabolism.[7] Vitamin D deficiency has been linked to various health conditions, including common types of cancer, autoimmune diseases, cardiovascular diseases, musculoskeletal diseases, and infectious diseases.[8] There are few foods that are a source of vitamin D, such as oily fish or fish oil. Humans mainly meet their vitamin D needs through sun exposure. Ultraviolet B (UVB) in sunlight triggers vitamin D synthesis in the skin. UVB causes the conversion of provitamin D (7-dehydrocholesterol) to previtamin D3 and then to vitamin D3 in the skin. Vitamin D3 synthesized in the skin is first hydroxylated in the liver, forming 25(OH) vit D. The kidney hydroxylates 25(OH) vitamin D to form the metabolically active 1,25(OH) vitamin D. This active form directly affects intestinal calcium absorption, bone mineralisation, and muscle tissue contractile activity.[9]

Cite this article: Soy F, Çakır AD, Pehlivan O, Aydemir M, Dündar T. Prevalence of vitamin D deficiency and insufficiency in adults in Ankara province. *J Orthop Res Rehabil.* 2024;2(1):1-4.

To evaluate an individual's vitamin D level, it is recommended to examine their 25(OH)D level. This level has a half-life of 2-3 weeks and reflects both vitamin D intake and endogenous production. The biologically active form, 1,25(OH)2D, is not ideal for measurement due to its short half-life of 4-6 hours and circulating levels that are 1000 times lower than 25(OH)D. Numerous studies have been conducted to define vitamin D deficiency and insufficiency and to determine the normal range of 25(OH)D levels. Based on these studies, vitamin D deficiency is defined as having a 25(OH)D level lower than 20 ng/mL, while vitamin D insufficiency is defined as having a level between 21 and 29 ng/mL. An adequate level is considered to be higher than 30 ng/mL (with a preferred range of 40-60 ng/mL). Vitamin D intoxication is diagnosed when the level is higher than 150 ng/mL.[10] These values were accepted as reference values when forming the patient groups for our study.

In adults, vitamin D deficiency can cause proximal muscle weakness, defects in skeletal mineralisation, and an increased risk of falls, leading to an increased risk of fractures. Generalised body aches are often reported by patients with vitamin D deficiency.[9,10] We planned this study to elucidate the underlying etiology of these complaints, which we frequently encounter in daily outpatient clinic applications, and to diagnose vitamin D deficiency. The aim of this study was to determine the frequency of vitamin D deficiency by examining vitamin D levels in individuals over the age of 18 who applied to our secondary level state hospital. Additionally, we investigated whether there was a significant difference between 25-OH D levels based on age, gender, and seasonal factors.

METHODS

Ankara Etlik City Hospital Clinical Researches Ethics Committee granted ethical approval to our study (Date: 22.11.2023, Decision No: AEŞH-EK1-2023-704), and we obtained institutional permission from the Chief Physician Office of Kahramankazan State Hospital. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

From 01.01.2022 to 01.07.2023, we retrospectively analysed the results of 25-OH D level requests from patients over the age of 18 who visited the Orthopaedics and Traumatology Outpatient Clinic and Internal Medicine Outpatient Clinic of Kahramankazan State Hospital. The hospital information system was used for this purpose. The study excluded patients with chronic diseases such as diabetes mellitus, hypertension, thyroid diseases, and chronic renal failure. The study included 12,748 patients who were classified into different age groups. The 'Guideline for the Diagnosis and Treatment of Metabolic Bone Diseases' published by The Society of Endocrinology and Metabolism of Turkey in 2012 categorises patients into four groups based on their serum 25(OH) vitamin D concentration: severe vitamin D deficiency (<10 ng/mL), vitamin D deficiency (11-20 ng/mL), vitamin D insufficiency (21-29 ng/mL), and normal (>30 ng/mL).[9] The study divided patients into three groups based on their vitamin D levels:

1. those with a deficiency (<20 ng/mL)
2. those with insufficient levels (21-29 ng/mL)
3. those with normal vitamin D values (>30 ng/mL)

Statistical Analysis

The hospital information system data was computerised. Statistical evaluations were performed using the SPSS (26.0 for Windows) programme. Continuous variables were expressed as mean ± standard deviation. Binary Logistic Regression analysis was used to determine the risk factors for vitamin D deficiency. To determine the independent variables to include in the regression model, subgroups (with and without vitamin D deficiency) of the dependent dichotomous variable (vitamin D deficiency) were compared in terms of age, sex and distribution by month. We used the Mann Whitney U test to compare the mean age of patients with and without vitamin D deficiency. We analysed categorical data (months, gender) using the Pearson Chi-Square test. Binary logistic regression analysis included independent variables that showed significant differences, such as month, age, and gender. Results were considered statistically significant when the P value was less than 0.05.

RESULTS

The demographics of 12,740 patients, including 9,550 women and 3,190 men, are shown in Table 1. The highest proportion of patients who had their serum 25(OH) vitamin D concentration tested for vitamin D deficiency were aged between 45 and 64 years, accounting for 33.9%. This was followed by the patient group aged between 30 and 44 years, which accounted for 30.3% (Table 1).

Table 1. Demographic characteristics

Variable		n	%	N	
Gender	Female	9550	75,0	**12740**	**100**
	Male	3190	25,0		
Age	18-29	2626	20,6	**12740**	**100**
	30-44	3864	30,3		
	45-64	4322	33,9		
	65-74	1296	10,2		
	75-89	614	4,8		
	90 and above	25	0,2		
	Min. 8	**Max.** 99	**Mean** 45	**Std.** 10,8	

When analysing the seasonal distribution of outpatient clinic applications for the patients included in the study, it was found that 4,012 patients (31.5%) applied to the hospital during the summer season (Table 2).

Table 2. Seasonal distribution of patient visits to health institutions

Season	n	%
Spring	3897	30,6
Summer	4012	31,5
Autumn	2127	16,7
Winter	2704	21,2
	12740	**100**

The study participants were divided into three groups based on their serum 25(OH) vitamin D levels (Table 3). Of the total number of patients, 8,740 (68.6%) had vitamin D deficiency (<20 ng/mL), 2,700 (21.2%) had vitamin D insufficiency (21-29 ng/mL), and 1,300 (10.2%) had normal vitamin D levels (>30 ng/mL). The combined percentage of patients with vitamin D deficiency and insufficiency was 89.8% (Table 3).

Table 3. Distribution of serum 25(OH) vitamin D concentration in patients		
Serum 25(OH) vitamin D concentration	**n**	**%**
<20 ng/mL	8740	68,6
21-29 ng/mL	2700	21,2
>30 ng/mL	1300	10,2
	12740	**100**

The study found that female patients and those at relatively young ages were more likely to have Vitamin D deficiency (Tables 4 and 5). Analysis of serum 25(OH) Vitamin D concentrations by sex revealed that 71% of women and 61.5% of men had Vitamin D deficiency, indicating a significant correlation between serum 25(OH) Vitamin D concentration and gender ($\chi 2=9.003$ $p<0.001$). Female patients were found to have a vitamin D deficiency approximately 3.5 times more often than male patients. Additionally, their vitamin D levels were lower compared to male patients.

Table 4. Distribution of serum 25 (OH) vitamin D concentration in patients by gender						
Gender	**Serum 25 (OH) vitamin D concentration**					
	<20 ng/mL		**21-29 ng/mL**		**>30 ng/mL**	
	n	**%**	**n**	**%**	**n**	**%**
Female	**6780**	**71**	1840	19,3	930	9,7
Male	1960	61,5	860	26,9	370	11,6
	8740	**68,6**	**2700**	**21,2**	**1300**	**10,2**

When analysing the distribution of serum 25(OH) vitamin D concentrations among the patients included in the study, it was found that the most common age range for patients with vitamin D deficiency was 45-64 years old, with 2,817 patients. The 18-29 age group had the highest rate of vitamin D deficiency at 77.1% (Table 5). It is evident that the majority of patients with vitamin D deficiency were under the age of 65. There was a significant correlation between vitamin D levels and age periods ($\chi 2=2.064$, $p<0.001$).

Table 5. Distribution of serum 25 (OH) vitamin D concentration of patients by age groups						
Age periods	**Serum 25 (OH) vitamin D concentration**					
	<20 ng/mL		**21-29 ng/mL**		**>30 ng/mL**	
	n	**%**	**n**	**%**	**n**	**%**
18-29	**2025**	**77,1**	454	17,3	147	5,6
30-44	2679	69,4	838	21,7	344	8,9
45-64	2817	65,2	1001	23,2	501	11,6
65-74	804	62,1	278	21,5	213	16,4
75-89	396	64,5	125	20,4	4	16
90 and above	19	76	4	16	2	8
	8740	**68,6**	**2700**	**21,2**	**1300**	**10,2**

A significant correlation was found between vitamin D levels and seasonal periods when the distribution of serum 25(OH) vitamin D concentrations of the patients included in the study was analyzed according to the seasons ($\chi 2=3.704$ $p<0.001$). The incidence of vitamin D deficiency was highest during the spring months ($p<0.001$) (Table 6). The results of the binary logistic regression analysis indicate that gender, age, and the months in which vitamin D deficiency is detected are significant risk factors for low 25(OH)Vit D levels.

Table 6. Distribution of Serum 25 (OH) vitamin D concentration of patients according to seasons						
Season	**Serum 25 (OH) Vitamin D Concentration**					
	<20 ng/mL		**21-29 ng/mL**		**>30 ng/mL**	
	n	**%**	**n**	**%**	**n**	**%**
Spring	2920	74,9	632	16,2	345	8,9
Summer	2390	59,6	1108	27,6	514	12,8
Autumn	1340	63	574	27	213	10
Winter	**2090**	**77,3**	386	14,3	228	8,4
	8740	**68,6**	**2700**	**21,2**	**1300**	**10,2**

DISCUSSION

Studies from various countries indicate that vitamin D deficiency is a global health issue.[11] Inadequate levels of 25(OH)D are highly prevalent and are associated with fragility fractures, particularly hip fractures, and mortality.[12] Hovsepian et al.[13] reported a high prevalence of vitamin deficiency (50.8%) in the adult population attending polyclinics for routine check-ups. Mansoor et al.[14] conducted a study in Pakistan and found that the mean vitamin D level was 16.44 ng/mL. They also identified vitamin D deficiency in 69.9% of participants and vitamin D insufficiency in 21.1%, which closely aligns with the results of our study. A study conducted by Hekimsoy et al.[15] in 2010 found that the mean 25(OH) D level was 16.9±13.09 ng/mL. Of these, 74.9% had vitamin D deficiency (<20 ng/mL), 13.8% had vitamin D insufficiency (20-29.99 ng/mL) and 11.3% had normal values (>30 ng/mL). It is possible that the higher prevalence of vitamin D deficiency in this study compared to ours is related to the fact that it was conducted on a relatively younger patient population. In a study conducted by Uçar et al.[16] in Ankara province, the same region as our study, a high rate of vitamin D deficiency (51.8%) and vitamin D insufficiency (20.7%) were found. In our study, when 20 ng/mL was taken as the cut off value, 68.6% vitamin D deficiency and 21.2% vitamin D insufficiency were found in patients admitted to our hospital.

Regions far from the equator with insufficient sunlight have been observed to have decreased levels of vitamin D produced through the skin. This is a concern for the European population.[17] In cases of vitamin D deficiency, which is evident in closed clothing, it is recommended to take oral supplements or consume vitamin D-enriched foods. However, direct sunlight exposure of the face and hands for at least 10-15 minutes twice a week is sufficient for vitamin D synthesis.[9-17] Studies conducted in Middle Eastern and Asian countries have found a high prevalence of vitamin D deficiency.6 Similarly, studies conducted in Turkey have also reported a high prevalence of vitamin D deficiency.[4,15,16]

Serum 25(OH) vitamin D level shows seasonal variation. In the studies in the literature; serum 25(OH) vitamin D level reaches the highest level in summer.[18-19] Individuals living at latitudes of 37° and above are at a higher risk of vitamin D deficiency during winter months due to reduced UVB radiation. Denmark, located at 56°00' north latitude, reports common vitamin D deficiency during the winter-spring period.[19] Similarly, our country, located at 39°57' North latitude, may also experience vitamin D deficiency during the winter-spring period. The study results indicate that vitamin D deficiency is more prevalent during the spring months. Additionally, studies conducted in our country have identified the spring season as a risk factor.[16]

Vitamin D deficiency is more prevalent in women and at younger ages in the adult population.[13,15,19] Çidem et al.[20] found no significant gender difference in 25(OH)D levels. However, Hekimsoy et al.[15] reported that 25(OH)D deficiency was more common in women (78.7%) than in men (66.4%). Our study's findings align with those of Hekimsoy et al.[15] The higher prevalence of vitamin D deficiency in the young population may be due to the increased number of indoor work activities during their daily lives. Modern working life often requires people to stay indoors for 10-12 hours a day. In the region where the hospital where this study was conducted is located, industrial and factory settlement is highly developed, and the majority of those working in this sector are in the young age group. Staying indoors all day may lead to insufficient sun exposure and an increased risk of vitamin D deficiency. The higher prevalence of vitamin D deficiency in women and at younger ages may be due to awareness of osteoporosis prevention or the widespread use of vitamin D for treating osteoporosis in the elderly population.

This was a cross-sectional study conducted using archive search methods. To improve the accuracy of defining the relationship between complaints and vitamin D deficiency in patients admitted to the Orthopaedics and Traumatology Outpatient Clinic and Internal Medicine Outpatient Clinic, it would be beneficial to conduct prospective studies in a multicentre manner.

CONCLUSION

A high rate (89.8%) of vitamin D deficiency and insufficiency was detected in patients admitted to our hospital from Ankara and its neighbourhood, and it was concluded that this condition is more common in women and relatively younger ages and in spring months. We believe that dietary support and vitamin D supplementation may be appropriate for individuals at risk. Additionally, patient education on the importance of sun exposure and dietary intake may also aid in treatment.

ETHICAL DECLARATIONS

Ethics Committee Approval

Ankara Etlik City Hospital Clinical Researches Ethics Committee granted ethical approval to our study (Date: 22.11.2023, Decision No: AEŞH-EK1-2023-704), and we obtained institutional permission from the Chief Physician Office of Kahramankazan State Hospital.

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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