Turkish Journal of Medical Sciences

http://journals.tubitak.gov.tr/medical/

Research Article

Turk J Med Sci
(2017) 47: 728-731

doi:10.3906/sag-1508-30

Prevalence and risk factors for vitamin D deficiency in patients with widespread musculoskeletal pain

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Received: 07.08.2015 • **Accepted/Published Online:** 17.02.2016 • **Final Version:** 12.06.2017

Background/aim: The aim of this study was to examine the prevalence of 25-hydroxyvitamin D (25(OH) vitamin D) deficiency in patients complaining of widespread musculoskeletal pain.

Materials and methods: In this cross-sectional study, 14,925 patients (13,589 females and 1336 males; mean age: 47.0 years, range: 20–99 years) were included. Serum 25(OH) vitamin D was measured by ELISA. The patients were classified into two groups: 1) patients with vitamin D deficiency (<20 ng/mL) and 2) patients without vitamin D deficiency (>20 ng/mL).

Results: The prevalence of vitamin D deficiency was 73.9%. A multivariate logistic regression model showed that low 25(OH) vitamin D level was associated with sex, age, and month in which 25(OH) hypovitaminosis was determined. The risk of a low 25(OH) vitamin D was level was 1.74 times higher in female patients than in males. The risk of low 25(OH) vitamin D level was highest in March during the year.

Conclusion: Our results indicate that vitamin D deficiency should be considered in patients with widespread musculoskeletal pain and some precautions, such as sunbathing during summer, should be recommended for patients with a risk of vitamin D deficiency.

Key words: Osteomalacia, vitamin D, widespread musculoskeletal pain

1. Introduction

Vitamin D deficiency is a worldwide health problem and has been associated with a number of chronic diseases, including common types of cancer, autoimmune diseases, cardiovascular diseases, musculoskeletal diseases, and diseases involving infections (1).

Only a few foods are considered vitamin D sources, such as fatty fish species or fish oil. Humans primarily meet their vitamin D needs through sunlight. Ultraviolet B (UVB) rays present in sunlight trigger the synthesis of vitamin D in the body. UVB ensures that provitamin D (7-dehydrocholesterol) is converted initially to previtamin D3 and then to vitamin D3 in the skin. Hydroxylation of vitamin D occurs in the liver after synthesis in the skin and then 25(OH) vitamin D is formed. This is followed by a second hydroxylation in the kidneys, which leads to the formation of metabolically active 1,25(OH) vitamin D. Active vitamin D regulates the absorption of calcium through the intestines and musculoskeletal and osteoblastic activities (1,2).

Vitamin D deficiency in adults is associated with proximal muscular weakness, skeletal mineralization defects, and an increased risk of falling. Patients with vitamin D deficiency commonly complain of widespread musculoskeletal pain (2). The aim of this study was to examine the prevalence of 25(OH) vitamin D deficiency in patients complaining of widespread musculoskeletal pain.

2. Materials and methods

Patients who consulted our Physical Therapy and Rehabilitation Department during 2011–2014 were reviewed for this study. The review was carried out via the hospital database archives. As a result, 15,379 patients with widespread musculoskeletal pain, aged 20–99 years, were screened in the study. Of these patients, 454 were excluded due to their refusal of giving a blood sample to measure 25(OH) vitamin D. This cross-sectional study was completed with 14,925 patients.

Serum 25(OH)D levels were measured using the ADVIA Centaur and ADVIA Centaur XP systems (Siemens Healthcare Diagnostics). Blood samples were collected between 0800 and 1000 hours, following fasting for ≥8 h. Blood samples were obtained from the antecubital vein. Serum samples were frozen and stored at –20 °C until

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assayed. The normal reference range of our laboratory for serum 25(OH)D level is 30–100 ng/mL.

According to the Guidelines for Diagnosis and Treatment of Metabolic Bone Diseases, which was published by the Society of Endocrinology and Metabolism of Turkey in 2012, serum 25(OH) vitamin D can be assessed in four categories: severe vitamin D deficiency if serum 25(OH) D level is <10 ng/mL; vitamin D deficiency if the level is 11–20 ng/mL; vitamin D inadequacy if the level is 21–30 ng/mL; and normal if the level is >30 ng/mL (3). Patients were divided into two categories of patients with 25(OH) D deficiency (serum 25(OH) D < 20 ng/mL) and patients without 25(OH) D deficiency (serum 25(OH) D > 20 ng/mL).

Continuous variables are expressed as mean ± standard deviation. The mean age of the patients with and without vitamin D deficiency was compared using the Mann–Whitney U test. Categorical data were analyzed using the Pearson chi-square test. Serum 25(OH) vitamin D level was analyzed using a 2 × 2 [group (patients with vitamin D deficiency and patients without vitamin D deficiency) × sex (male and female)] ANOVA model appropriate for general linear model univariate variance analysis. Multivariate binary logistics regression analysis was performed to determine risk factors for vitamin D deficiency. The P-value for a factor to be included in the regression model was 0.05 using the forward conditional method, and the P-value for exclusion was 0.1. Suitability of the regression model was reviewed with the Hosmer–Lemeshow test. The regression model was considered statistically suitable if the P-value found with the Hosmer–Lemeshow test was <0.05 (4). The 95% confidence intervals were calculated for the odds ratios. Wald statistical analysis was conducted to determine the significance of coefficient B. P < 0.05 was considered significant. SPSS 10.0 (SPSS Inc., Chicago, IL, USA) was used for analyses.

3. Results

A total of 11,029 (73.9%) patients had vitamin D deficiency. Vitamin D deficiency was more common among females and younger patients (Table 1). The mean serum 25(OH) vitamin D level was lower in females and patients with vitamin D deficiency. For serum 25(OH) vitamin D, a group effect (F: 10,636.9, df: 1, P < 0.0001) and group-by-sex interaction were found (F: 5321.9, df: 1, P < 0.0001) (Table 2).

The peak prevalence for vitamin D deficiency was in March during the year and the lowest level occurred in August (chi-square: 80.39, df: 11, P < 0.0001; Figure).

The binary logistics regression analysis revealed that sex, age, and the month during which vitamin D deficiency was observed were important predictors (risk factor) of a low 25(OH) vitamin D level (Nagelkerke R^2 = 0.048, Hosmer–Lemeshow test P = 0.123). The risk of 25(OH) vitamin D deficiency was 1.74-times higher among females than among males, and risk peaked during March (Table 3).

Table 1. Demographic characteristics of the patients.

	With vitamin D deficiency (n = 11,029)	Without vitamin D deficiency (n = 3896)	P-value
Age (years)	45.7 ± 14.5	50.6 ± 15.2	<0.0001
Sex (female/male)	10,186/843 (=12.1)	3403/493 (=6.9)	<0.0001

Age data are expressed as arithmetic mean ± standard deviation.

Table 2. The mean serum 25(OH) vitamin D level in male and female patients with and without vitamin D deficiency.

	With vitamin D deficiency	Without vitamin D deficiency
Male	12.7 ± 4.3 ng/mL (843)	27.7 ± 7.0 ng/mL (493)
Female	10.5 ± 4.6 ng/mL (10,186)	29.9 ± 7.8 ng/mL (3403)
Total	10.7 ± 4.6 ng/mL (11,029)	29.6 ± 7.8 ng/mL (3896)

Age data are expressed as arithmetic mean ± standard deviation (number of cases).

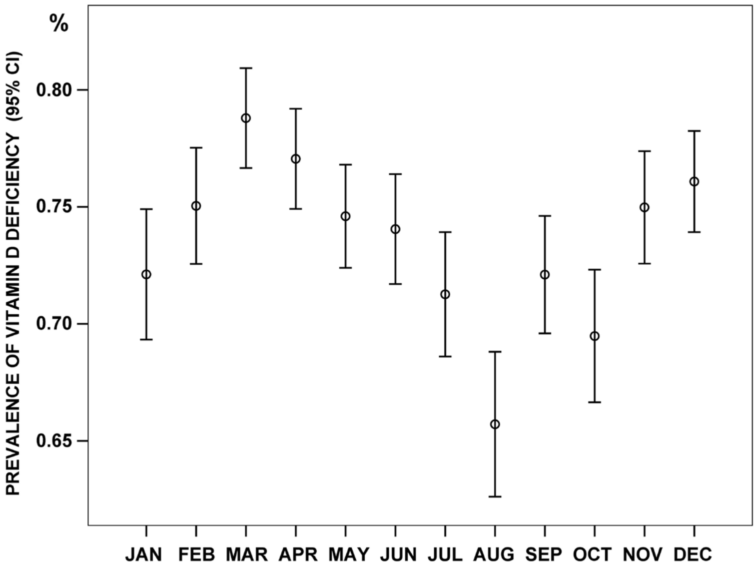

Figure. Annual frequency distribution of 25(OH) vitamin D deficiency (%). Error bars (95% confidence intervals) show that the frequency of vitamin D deficiency was highest in March and lowest in August.

Table 3. Regression model for 25(OH) D deficiency.

	B	SE	Wald	df	P-value	Odds ratio	95% CI	
							Lower limit	Upper limit
Age	–0.023	0.001	331.7	1	<0.0001	0.977	0.975	0.980
Sex (male)*	0.557	0.061	82.4	1	<0.0001	1.745	1.548	1.968
Month (January)*	0.372	0.101	13.5	1	<0.0001	1.450	1.189	1.768
Month (February)*	0.515	0.099	27.1	1	<0.0001	1.674	1.379	2.031
Month (March)*	0.760	0.097	60.9	1	<0.0001	2.137	1.766	2.587
Month (April)*	0.667	0.095	49.2	1	<0.0001	1.948	1.617	2.346
Month (May)*	0.499	0.093	28.6	1	<0.0001	1.648	1.372	1.978
Month (June)*	0.500	0.095	27.4	1	<0.0001	1.649	1.368	1.988
Month (July)*	0.292	0.098	8.8	1	<0.003	1.339	1.105	1.622
Month (September)*	0.363	0.096	14.1	1	<0.0001	1.437	1.190	1.736
Month (October)*	0.200	0.099	4.0	1	<0.043	1.222	1.006	1.484
Month (November)*	0.521	0.097	28.6	1	<0.0001	1.683	1.391	2.037
Month (December)*	0.610	0.094	41.9	1	<0.0001	1.840	1.530	2.213
Coefficient	1.193	0.106	125.6	1	<0.0001	3.295		

*Reference categories are “male” for sex and “August” for month.
SE, Standard error; df, degrees of freedom; CI, confidence interval.

4. Discussion

Vitamin D is an important factor regulating musculoskeletal functions (1,2). We determined the vitamin D deficiency rate among patients suffering from widespread musculoskeletal pain. As a result, vitamin D deficiency was common among patients with widespread musculoskeletal pain. The risk of vitamin D deficiency was particularly high during spring and among female patients.

Hovsepian et al. reported that the prevalence of vitamin D deficiency is high (50.8%) among the adult population consulting the hospital for routine check-ups. In this study, the prevalence of vitamin D deficiency was even higher (73.9%).

Serum 25(OH) vitamin D levels vary depending on the season and peak during summer months (5,6). The latitudinal position of a country is the most important factor impacting seasonal changes in vitamin D levels. The sun's rays hit the earth at an oblique angle during November–February in countries located north of the 37th parallel; thus, they are mostly absorbed by the ozone layer. As fewer UVB rays reach the earth's surface during winter, those who live north of the 37th parallel have a higher predisposition to vitamin D deficiency (1,7). The latitude of Iran is 36°00′N and no seasonally significant changes in serum vitamin D levels have been observed in Iran (8). However, vitamin D deficiency is common during winter and spring in Denmark, which is located at 56°00′N (5). Turkey is situated at 39°57′N, which is between Iran and Denmark. According to our results, vitamin D deficiency is most common during the month of March.

Vitamin D deficiency is more prevalent among females and younger individuals (5,8,9), which is consistent with our results. An important reason why vitamin D deficiency is more prevalent in this population may be that their activities outdoors are limited because individuals living in modern urban areas are obliged to reside in flats rather than single detached houses with gardens. Similarly, modern working life forces people to stay indoors 10–12 h/day. The textile industry is relatively well developed in the area near the hospital where this research was conducted, and employees in those textile facilities are mainly younger females. The increased risk of vitamin D deficiency may be due to their remaining in closed spaces and being unable to adequately sunbathe.

Another reason why vitamin D deficiency is more prevalent among younger females may be that the use of vitamin D supplements is more common among the older population as a measure against osteoporosis or as part of osteoporosis treatment.

Our results suggest that vitamin D deficiency is a common problem in patients, particularly females, with musculoskeletal pain. Thus, vitamin D deficiency should be considered in patients who complain of widespread musculoskeletal pain. Some preventive measures, such as adequate sunbathing, can be recommended to patients who have widespread musculoskeletal pain associated with vitamin D deficiency.

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