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ORIGINAL PAPER

High prevalence of vitamin D insufficiency in community-dwelling postmenopausal Polish women

Artur Stolarczyk[1], Andrea Horvath[2], Monika Szczechura[1], Magda Kamińska[1], Piotr Dziechciarz[2]

[1]Clinical Rehabilitation Department, Medical University of Warsaw, Poland
[2]Department of Paediatrics, Medical University of Warsaw, Poland

Abstract

Introduction: Inadequate vitamin D level is associated with altered bone turnover and bone loss, which increases the fracture risk.

Aim: To assess the seasonal prevalence of inadequate (insufficient or deficient) serum vitamin D levels in community-dwelling postmenopausal Polish women screened for osteoporosis.

Material and methods: A cross-sectional observational study based on the regional urban non-institutionalized sample (n = 107) of postmenopausal Caucasian women in the age range of 51-83 years, not taking any medication and free from any condition likely to affect vitamin D status or calcium/bone metabolism. The outcome measures were the mean 25-OH vitamin D level across all the seasons and the percentage of vitamin D deficiency and insufficiency and defined as < 20 ng/dl (50 nmol/l) and 20-30 ng/dl (50-75 nmol/l), respectively.

Results: No statistically significant difference has been found in the mean vitamin D level, regardless of the season (p = 0.4). The prevalence of vitamin D deficiency and insufficiency were in spring 54% and 32%, in summer 46% and 46%, in autumn 67% and 27%, and in winter 61% and 22%, respectively.

Conclusions: Vitamin D inadequacy is common in a sample of Polish community-dwelling postmenopausal women regardless of the season.

Key words: osteoporosis, cross-sectional study, screening.

Introduction

It has been postulated that vitamin D plays an active role not only in calcium/phosphate homeostasis and proper bone metabolism, but also in the prevention of cancer, autoimmune conditions, cardiovascular disease, infections, cognitive decline and a number of other conditions [1]. Although vitamin D can be delivered with diet, the number of foods naturally containing vitamin D in significant amounts is very limited. Levels of circulating 25-hydroxyvitamin D – 25(OH)D – are largely determined by skin production that occurs in response to the solar UVB radiation [2, 3].

However, at latitudes above 33°, UV-B radiation is only effective in activating vitamin D production during the summer months at the time of the midday [4]. In recent decades, several lifestyle changes, such as time spent indoors, sun avoidance due to skin cancer prophylaxis, the topical application of a sunscreen and increased pollution contribute to vitamin D inadequacy in European countries including Poland [5]. In 2013, the Central European group of experts have established recommendations for prophylactic vitamin D supplementation which advised universal supplementation of 800-2000 IU/day of vitamin D in patients over 65 years of age, throughout the year [6]. In adults below 65 years, the total supplementation of vitamin D should be provided between September and April, with a dose of 800-2000 IU/day and throughout the whole year in the case of inadequate vitamin D skin synthesis during the summer time. However, recommendations were based on expert opinions supported by studies performed in other countries because data regarding the vitamin D status across various age groups of the Polish population is still very limited [7].

The aim of the study was to evaluate the level of vitamin D at different times of the year in the community-dwelling outpatient sample of postmenopausal women.

Material and methods

This study was a cross-sectional observational study based on the regional urban non-institutionalized sample of postmenopausal Caucasian women, over 50 years of age. The study took place in Warsaw, Poland (52.26°N) between 1.01.2009 and 30.05.2010.

Corresponding author:
Piotr Dziechciarz, Department of Paediatrics, Medical University of Warsaw, 1 Dzialdowska St., 01-184 Warsaw, Poland, phone: +48 22 452 33 09, e-mail: piotrdz@hotmail.com

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The primary outcome measure was the mean 25(OH)D level across all the seasons (winter: January – March, spring: April – June, summer: July – September, autumn: October – December). The secondary endpoints were the percentage of vitamin D insufficiency and deficiency in the studied group and odds ratio of being sufficient or deficient with vitamin D in the postmenopausal women aged less than 65 years compared to older ones.

Patients referred to the outpatient clinic for initial screening for osteoporosis were invited to participate into the study. Women were consecutively enrolled, with no influence on the referral by any of the researchers. Women were eligible for this study if they had been postmenopausal for at least 1 year. The exclusion criteria were previous therapy for osteoporosis, renal, hepatic, or bowel dysfunction (inflammatory bowel disease and malabsorption), diabetes mellitus type 1 or 2 and uncontrolled thyroid or parathyroid gland dysfunction. After receiving information from the investigator, and being able to ask questions regarding any aspect of the study, all participants provided written informed consent before enrolment. Blood samples were obtained after overnight fasting between 8 AM and noon. Samples were centrifuged (1800 g, 10 min, room temperature), separated and stored at –20°C until analysed.

The serum 25(OH)D level was measured by chemiluminescence immunoassay with standard kits (LIAISON®, DiaSorin Inc., Stillwater, United States; inter-assay precision 5%, intra-assay precision 7%). For group discrimination, we used 20 ng/ml as the critical value for deficiency and 30 ng/ml as the cut-off value for insufficiency. The values over 30 ng/ml were considered to be the optimal 25(OH)D level according to expert recommendations.

In all patients, dual energy X-ray absorptiometry examination was performed using the LUNAR Prodigy (GE-Lunar Corp., Madison, Wisconsin, USA) densitometer. Bone mineral density (BMD) was measured at L2-L4 lumbar spine in women below 65 years and femur neck over 65 years. The coefficient of variation of the technique at our laboratory was 0.8% using the anatomical spine phantom measure daily. Bone mineral density was expressed as *T*-score, a number of standard deviations from the mean of young women attaining peak bone mass. We considered osteoporosis when the lumbar spine or femur neck *T*-score was equal or below –2.5 standard deviation.

The study was accepted by the Ethics Committee at the Medical University of Warsaw.

Statistical analysis

Descriptive statistics are presented as mean and standard deviation (SD), as applicable. Categorical variables were expressed as a number of subjects and percentage with 95% confidence intervals (95% CI). χ^2 test was used to compare the groups of categorical variables. One-way analysis of variance (ANOVA) was used for season group comparison. A value of $p < 0.05$ was considered statistically significant.

Results

Of potentially 135 eligible women, altogether 115 patients participated in the study. One hundred and seven blood samples – 28 obtained in spring, 26 in summer, 30 in autumn, 23 in winter – were finally analysed. Eight blood samples were not analysed because of either loss or improper storage conditions. The group characteristics (age, BMI, % of patients with osteoporosis) are shown in Table I.

There has been no statistically significant difference found in the mean vitamin D level regardless of the season (SS: 366,367, *df*: 3, MS: 128,789, *F*: 0.985, *p*: 0.403) (Table II). Altogether 12 (11%) participants showed vitamin D sufficiency and 61 (57%) demonstrated vitamin D deficiency according to predefined criteria (Table II). Only small percentages of patients (6-17% of patients depending on the season) had the adequate serum level of 25(OH)D. Compared to younger women, patients > 65 years had a statistically significant increased odds ratio for vitamin D deficiency (7.6, 95% CI: 21-47.1) and decreased OR for vitamin sufficiency (0.16, 95% CI: 0.04-0.68) in summer with no difference found in other seasons (data not shown).

Discussion

The results of our study show than there has been no seasonal pattern in the mean 25(OH)D level in the

Tab. I. Group characteristics

	Spring *n* = 29	Summer *n* = 31	Autumn *n* = 31	Winter *n* = 24
Mean age ± SD (years)	71.4 ± 8.7	70.6 ± 7.9	70.0 ± 7.0	71.6 ± 6.6
Mean body mass index ± SD	29 ± 4.2	28.7 ± 3.8	28.3 ± 3.2	29.2 ± 4.1
% of patients with osteoporosis	81	77	77	84
***N* (%) of patients > 65 y**	22 (76%)	23 (74%)	21 (68%)	20 (83%)

Tab. II. Vitamin D supply by season

	Number of patients	Mean 25(OH)D level ± SD (ng/ml)	Vitamin D deficiency % (*n*) of pts	Vitamin D insufficiency % (*n*) of pts	Vitamin D suficiency % (*n*) of pts
Spring	28	18.6 ± 10.5	54% (15)	32% (9)	14% (4)
Summer	26	21.6 ± 11.0	46% (12)	46% (12)	8% (2)
Autumn	30	17.6 ± 8.5	67% (20)	27% (8)	6% (2)
Winter	23	21.3 ± 15.2	61% (14)	22% (5)	17% (4)

outpatient population of Polish postmenopausal women. Only approximately 11% of participants showed vitamin D sufficiency, whereas 57% of the analysed group showed deficiency defined as 25(OH)D level less than 20 ng/ml.

Although serum 25(OH)D is the foremost indicator of vitamin D status, much debate surrounds the biochemical definition of adequacy of vitamin D in the general population. Various thresholds for vitamin D adequacy have been used. We assumed the 25(OH)D threshold of at least 30 ng/ml as optimal fracture prevention based on 2010 International Osteoporosis Foundation position statement on vitamin D [8], the 2011 US Endocrine Society Task Force on Vitamin D [9], European Menopause and Andropause Society position statement released in 2012 [10] and Central European recommendations [6].

As there is no consensus on the cut-offs used to identify the adequate vitamin D level and assays used for the 25(OH)D assessment differs among studies, making it difficult to compare results, our data are similar to the results of other European studies [11-16]. However in most but not in all [17] of them a significant seasonal variation has been noted. The lack of the increase in vitamin D level in our population in the summer period seems to be attributed to culture-driven sun avoidance behaviour, clothing habits, scarce outdoor activities, or age-related decrease of vitamin D skin synthesis [18].

There is evidence that the elderly have one-fourth to one-fifth of the ability to make vitamin D from UV irradiation compared with adults younger than 30 years of age [19]. The results of our study suggest that in younger postmenopausal women, summer sun exposure seems to play a larger role in the prevention of vitamin D deficiency. Participants < 65 years have a significantly decreased odds ratio for being vitamin insufficient in summer but not in the other seasons compared to patients above that age. We did not measure vitamin D intake in our patients, nevertheless some studies suggest that ageing populations, have a greater dependency on dietary sources to maintain optimal vitamin D status [20, 21].

Recently published national representative food consumption data obtained from individuals showed that in 56% of Polish women > 60 years dietary intake of vitamin D is below the lower reference nutrient intake and almost all of them (96%) did not meet estimated average reference values [22]. In Polish diet, very few foods contain an appreciable amount of vitamin D, margarine is the only food mandated to be fortified with vitamin D and due to national eating habits, fish consumption frequency is still very low [23]. Population studies have reported higher rates of bone remodelling and fragility fracture during the winter, which suggests that any period of vitamin D insufficiency is unsuitable [24, 25]. Thus, vitamin D deficiency throughout the year may increase the age-related bone loss leading to the earlier osteoporosis [26]. In our population, 4/5 of patients have osteoporosis, however because of the cross-sectional study design, conclusion on the relationship between vitamin D status and bone mineral density is not possible.

These results should be interpreted in the light of the study's strengths and limitations. The study was based on a relatively small number of included females (n = 107). Thus, the results of our study should be viewed with caution. Moreover, it may be also argued that the patients included in the present study may not be representative for the entire population of Polish postmenopausal women. Women referred for osteoporosis screening might have been more self-aware or might have been considered to be at greater risk by their general practitioner of the risks of bone-calcium metabolism. However, referral was based on the postmenopausal status only, and since we did not influence referral, we regard the study population as randomly selected.

The results of the study might be biased because our laboratory was not a part of the international vitamin D assays quality assessment scheme (DEQAS) which, would have enhanced the comparability of the results with those performed by other laboratories and assay methods. We did not assess vitamin D oral intake, so based on the results of this study we cannot estimate relative contribution of diet in vitamin D supply. However, in the light of the fact that in Poland there is no universal vitamin D food fortification policy and typical Polish diet is not abundant in vitamin D, this study supports the need for universal supplementation in women.

Based on the results of our study we may speculate that vitamin D through the year supplementation policy should be expanded to all postmenopausal women in Poland. Nevertheless, an adequately powered community based study analysing vitamin D status in postmenopausal women aged less than 65 years is expected to provide a better answer for this assumption.

Conclusions

Vitamin D insufficiency is prevalent regardless of the season in an outpatient, community-dwelling sample of postmenopausal women living in Warsaw, Poland.

Disclosure

Authors report no conflicts of interest.

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