Environmental Factors and Vitamin D Status in Polish middle-aged women

Czynniki środowiskowe a poziom witaminy D u polskich kobiet w średnim wieku

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■ Abstract

Objectives. The aim of this study was to investigate the vitamin D levels in a population of middle-aged of women residing in the south-eastern part of Poland. Environmental factors (age, education, place of residence and BMI) that could affect vitamin D levels in a population of studied women were also examined.

Materials and method. The study was conducted at the Institute of Rural Health in Lublin, Poland, in a study group of women aged 45–65 years from the south-eastern part of the country. Serum lipids were determined using an automatic biochemistry analyzer and levels of 25(OH)D were measured using the 25OHD EIA assay Kits. Significance of the differences in quantitative characteristics was investigated using analysis of Man-Whitney test. Univariate correlations between the levels of 25(OH)D and variables were analyzed using the non-parametric Spearman test.

Results. The average of 25(OH)D level in the studied participants was 25.7±14.4 ng/L; more than 59% of participants had vitamin D deficiency. In particular, the mean 25(OH)D level in group of women with vitamin D deficiency was 14.7±6.1 ng/L. The mean age of the patients was 53.9±5.2 years; average age range – 45–65 years. BMI averaged 26.1±4.8 kg/m². This was a highly educated group with an average of 12.7±3.6 years of education, who lived mainly in towns (56.8%). Studies have shown that vitamin D deficiency in healthy middle-aged Polish women is significantly related to BMI and education. In the general population, no significant relationship was found between environmental factors (age, education, place of residence and BMI) and vitamin D levels.

Conclusion. Vitamin D supplementation is recommended for middle-aged women

Key words

environmental factors, middle-aged women, 25-hydroxy-vitamin D

■ Streszczenie

Cel pracy. Celem pracy było zbadanie poziomu witaminy D w populacji kobiet w średnim wieku zamieszkujących południowo-wschodnią część Polski. Badano również czynniki środowiskowe (wiek, wykształcenie, miejsce zamieszkania i BMI) mogące mieć wpływ na poziom witaminy D w populacji badanych kobiet.

Materiał i metody. Badanie zostało przeprowadzone w Instytucie Medycyny Wsi w Lublinie, a grupą badawczą były kobiety w wieku od 45 do 65 lat z południowo-wschodniej części kraju. Lipidy w surowicy określono za pomocą automatycznego analizatora biochemicznego, a poziomy 25 (OH) D zmierzono za pomocą zestawów testowych EIA 25 (OH) D (R&D Systems Minneapolis, USA). Istotność różnic w charakterystyce ilościowej zbadano za pomocą analizy testu Manna-Whitneya. Korelacje jednowymiarowe między poziomami 25 (OH) D i zmiennymi analizowano za pomocą nieparametrycznego testu Spearmana.

Wyniki. Średni poziom 25 (OH) D u badanych kobiet wynosił 25,7±14,4 ng/L, przy czym ponad 59% uczestniczek badania miało niedobór witaminy D. U kobiet z niedoborem witaminy D średni poziom 25 (OH) D wynosił 14,7±6,1 ng/L. Średni wiek kobiet wynosił 53,9±5,2 roku i mieścił się w przedziale od 45 do 65 lat. BMI wynosiło średnio 26,1±4,8 kg/m². Badane kobiety wykazywały dobre wykształcenie ze średnią 12,7±3,6 lat edukacji i mieszkały głównie w miastach (56,8%). Badania wykazały również, że niedobór witaminy D występujący u zdrowych Polek w średnim wieku jest w znacznym stopniu związany z BMI i poziomem wykształcenia. W populacji ogólnej nie stwierdzono istotnego związku pomiędzy czynnikami środowiskowymi (wiek, wykształcenie, miejsce zamieszkania i BMI) a poziomem witaminy D.

Wnioski. Rekomendowana jest suplementacja witaminy D u kobiet w średnim wieku.

Słowa kluczowe

czynniki środowiskowe, 25-hydroksy-vitamina D, kobiety w średnim wieku

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INTRODUCTION

Vvitamin D refers to a group of secosteroid hormones, including cholecalciferol (or vitamin D3) and ergocalciferol (vitamin D2). Vitamin D3 is produced in the skin under the

Medycyna Środowiskowa 2019, Tom 22, Nr 1–2

21

Grzegorz Raszewski, Konrad Jamka, Piotr Adamczuk. Environmental Factors and Vitamin D Status in Polish middle-aged women

influence of ultraviolet radiation (UVB and/or obtained from food, mainly fish. Ergocalciferol is synthesized by plants and fungi, which are the source of vitamin D2 in the diet. Both forms of vitamin D undergo hydroxylation to 25-hydroxy-vitamin D 25(OH)D, calcidiol) in the liver [1], and is the main storage and circulating form of vitamin D in the human body. Its concentration, as is universally acknowledged, reflects the status of the organism's vitamin D supply. In addition, 1,25-dihydroxy-vitamin D (1,25(OH)2D, calcidiol), the metabolite formed by hydroxylation of calcidiol, is responsible for the majority of the biological effects of this group of compounds, and the proposed determining factor of its synthesis at tissue level is the serum calcidiol concentration [2].

In numerous scientific reports, hypovitaminosis D (25(OH)D concentrations lower than 20 ng/ml have been associated in the pathogenesis of many diseases, including infectious, autoimmune, neoplasmatic, cardiovascular, metabolic and neurological diseases [3]. According to most authors, optimal vitamin D levels are defined as concentrations of 25(OH)D in serum ranges of 30–80 ng/ml. The concentration range of 20–30 ng/ml is defined as insufficiency, while levels above 100 ng/ml are considered a health risk, and greater than 200 ng/ml – toxic [4].

Hypovitaminosis D is mainly due to insufficient exposure to sunlight as well as insufficient supplementation [5]. The sources of vitamin D in the diet: fish, fish oils, as well as egg yolks, although to a lesser extent. Unfortunately, in Poland the intake of vitamin D from this source is very low [6]. Data concerning the vitamin D status in women in the Polish population are insufficient, particularly in the case of middle-aged women who do not have osteoporosis. These studies are important due to fact that it is well accepted that the middle-aged populations (> 45 years of age) are at high risk of vitamin D deficiency [4]. Moreover, some physiological and behavioural factors have been proposed as determinants of serum 25OH-D levels. These include, for example: gender, age, race and BMI. Knowledge of these determinants of vitamin D status is of importance for strategies for the prevention of suboptimal vitamin D status, especially during wintertime [7].

OBJECTIVE

The aim of this study was to investigate the vitamin D levels in a middle-aged population of women residing in the south-eastern part of Poland. According to the obtained data, environmental factors among the middle-aged participants with optimal and insufficiency vitamin D levels were also studied.

MATERIALS AND METHOD

Patients. The study was conducted at the Institute of Rural Health in Lublin, Poland, among a study group of women aged over 45 years living in the south-eastern part of the country. Patients were recruited among women who reported to the study facility to undergo a prophylactic densitometric examination. A total of 87 healthy women aged 45–65 were recruited. All participants signed a consent form prior to participation in the study, which was approved by the Ethics Committee at the Institute of Rural Health.

Sample collection, tests and assays. After an overnight fast, blood samples were taken from each patient. Serum samples were separated by centrifugation at 3,000 rpm over a period of 15 minutes, and then stored at -81°C until analysis. The serum cholesterol (TC), HDL-cholesterol (HDL-C) and triglyceride (TG) levels were determined using an automatic biochemistry analyzer (Express Plus, Chiron Diagnostics, USA), with reagents (Siemens Healthcare Diagnostics, Tarry-town, NY, USA), according to the procedure provided by the manufacturer. Serum levels of 25(OH)D were measured using 25OHD EIA assay Kits (R&D Systems Minneapolis, USA). Intra- and inter-batch variation coefficients for 25(OH)D were below 10%.

Statistical analysis. Data were expressed as the mean±standard deviation (SD), according to data distribution. The significance of the differences in quantitative characteristics between groups of 25-hydroxyvitamin D was investigated using analysis of the Man-Whitney test. Univariate correlations between the levels of 25(OH)D and selected variables were analyzed using the non-parametric Spearman correlation coefficient, according to data distribution. P>0.05 was considered not significant. Statistical analyses were carried out using Graph-Pad Prism-5 for Windows.

RESULTS

A total of 88 patients recruited by 25(OH) status (characteristics shown in Table 1) were finally analyzed in the study; average 25(OH)D level – 25.7±14.4 ng/L More than 59% of participants had vitamin D deficiency, in particular, the mean 25(OH)D level in group I with vitamin D deficiency was 14.7±6.1 ng/L while in females with group II (25(OH)D the level <30 ng/L was 35.1 ±5.1ng/L. The mean age of the patients was 53.9±5.2 years, with an age range of 45–65 years, and was similar in both groups. In addition, the BMI averaged 26.1±4.8 kg/m^2. The prevalence of obesity in females with II group was 25%, while in women with vitamin D deficiency – 19.2%, and 7.7% were underweight. This was a highly educated group with an average of 12.7±3.6 years of education, who lived mainly in towns (56.8%).

The levels of lipids: total cholesterol, HDL cholesterol, LDL cholesterol, and trigliceride were 218.0±48.6; 52.4±13.7; 144.1±45.1 and 146.0±61.2, respectively. No significant differences were observed in the characteristics between the two groups of studied women.

The relationship between the levels of 25(OH)D and environmental factors (age, education, environment and BMI) in the total population and in the 25(OH)D groups were analyzed. The results showed that the mean 25(OH)D serum concentrations in the total population was 25.7±14.4 ng/ml, which was not correlated with tested parameters (Tab. 2). However, as shown in the Figures, subgroup analysis showed an inverse relationship between the levels of 25(OH)D and BMI, as well as the education in women with vitamin D deficiency.

22

Medycyna Środowiskowa 2019, Tom 22, Nr 1–2

Grzegorz Raszewski, Konrad Jamka, Piotr Adamczuk. Environmental Factors and Vitamin D Status in Polish middle-aged women

Table 1. Characteristics of the study population

Prevalence, % 25-hydroxyvitamin D			
Characteristics	Total	≤ 30 ng/mL	> 30 ng/mL
	n = 88	Gr I, n = 52	Gr II, n = 36
Age, years; Mean (SD) *	53.9 (5.2)	53.5 (4.8)	54.5 (5.8)
Education, years; Mean (SD) *	12.7 (3.6)	12.5 (3.4)	13.1 (3.9)
8 years	20.4	15.4	27.8
9–12 years	42.0	50.0	27.8
> 12 years	37.6	34.6	44.4
Body Mass Index, kg/m²; Mean (SD) *	26.1 (4.8)	25.9 (5.3)	26.6 (4.1)
<18.5	4.6	7.7	0.0
18.5–25	38.6	40.4	36.1
25.0–30	35.2	32.7	38.9
>30	21.6	19.2	25.0
place of residence: Town	56.8	57.7	55.5
Little town	22.7	23.1	22.2
Village	20.5	19.2	22.3
25-hydroxyvitamin D, ng/mL Mean (SD)	25.7 (14.4)	14.7 (6.1)	35.1 (5.1)
Lipids: (mg/ml); Mean (SD)			
Total Cholesterol *	218.0 (48.6)	219.6 (45.3)	215.7 (53.6)
HDL-cholesterol *	52.4 (13.7)	50.4 (13.2)	55.2 (14.0)
LDL-cholesterol *	144.1 (45.1)	145.7 (44.1)	141.9 (47.1)
Triglycerides *	146.0 (61.2)	156.0 (66.5)	131.7 (50.0)

*There were no significant differences in age, years of education, body mass index (BMI), lipids levels between the 25-hydroxyvitamin D groups, using analysis of the Man-Whitney test.

Table 2. Relationship between levels of 25(OH)D and environmental factors

	25-hydroxyvitamin D		
Characteristics	Total; n=88	≤ 30 ng/mL; Gr I, n = 52	> 30 ng/mL; Gr II, n = 36
Age, years	p = 0.051 r = 0.176	p = 0.269 r = 0.087	p = 0.106 r = 0.213
Education, years	p = 0.132 r = 0.120	p = 0.029 r = 0.265	p = 0.209 r = −0.139
Body Mass Index, kg/m²	p = 0.421 r = 0.021	p = 0.034 r = −0.256	p = 0.387 r = 0.049
Environment	p = 0.140 r = 0.116	p = 0.113 r = 0.170	p = 0.060 r = 0.264
Total Cholesterol	p = 0.401 r = −0.027	p = 0.482 r = −0.006	p = 0.439 r = 0.026
HDL-cholesterol	p = 0.155 r = 0.110	p = 0.069 r = −0.208	p = 0.371 r = 0.057
LDL-cholesterol	p = 0.382 r = −0,033	p = 0,290 r = 0,078	p = 0.302 r = −0.089
Triglycerides	p = 0.085 r = −0.147	p = 0,196 r = 0,121	p = 0.394 r = −0.046

DISCUSSION

As is well known, vitamin D deficiency is the result of inadequate exposure to sunlight and inefficient production in the skin, not enough vitamin D in the diet, and certain health conditions, e.g. gastrointestinal, hepatic, and renal diseases [3]. Scientific evidence also indicates that it is common in people worldwide. Similarly, in Poland about 40% and 60% of pre- and post-menopausal women have a concentration of 25-(OH)D: lower than 20 ng/ml and 30 ng/ml, respectively [8]. This fact is important in the context of public health because vitamin D deficiency is independently associated with an increased risk of mortality in the general population, and is a particular risk for women, being associated, for example, with a higher risk of bone metabolic diseases [9].

The mean 25(OH)D serum concentrations in the studied population of women was 25.7±14.4 ng/ml, which is consistent with the latest research by other authors. In a recent study from 2019, Delle Monache et al. showed that more than 80% of women presented a serum 25(OH)D concentration lower than 30 ng/mL (75 nM), with the majority of values falling between 10–20 ng/mL [10].

In the current study, only educational level and place of residence are markers of socio-economic status, and the BMI level as a marker of diet and obesity. It is obvious that the diet is due to socio-economic status and social class, as well as education [11, 12], which may be linked to vitamin D status. This was not found in the entire population of women. However, a significant interaction was found between BMI levels, educational level and vitamin D, in women with vitamin D deficiency. Other studies also show that the BMI, together with the intake of alcohol, gender, ethnicity and tobacco use, are associated with the risk of vitamin D deficiency [10; 13]. There are also studies indicating that among the different clinical characteristics, BMI demonstrated the highest significant inverse correlation with serum 25(OH)D values, independent of season and age [10]. These results also indicate that vitamin D deficiency is more prevalent in those who are obese. Obesity and BMI levels are associated with lower vitamin D levels, and according to Tønnesen etnd al. and others, obesity is recognized as being associated with vitamin D deficiency as adipose tissue sequesters 25(OH)D, resulting in an inverse relationship between vitamin D and BMI [12]. This relationship is also shown in the current study.

Education, another significant factor in this study, was also examined and showed its relationship with 25 (OH) D levels in women with vitamin D deficiency. Similar results were obtained by Parva et all. who concluded that better educated people generally have better health awareness, which results in a statistically significantly lower rate of vitamin D deficiency [8].

In conclusion, this study reveals that vitamin D deficiency is present in healthy middle-aged Polish women, and that vitamin D deficiency is significantly associated with BMI and level of education.

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Medycyna Środowiskowa 2019, Tom 22, Nr 1–2

Grzegorz Raszewski, Konrad Jamka, Piotr Adamczuk. Environmental Factors and Vitamin D Status in Polish middle-aged women

23

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