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Risk factors of vitamin D deficiency among Ukrainian women in Carpathian region

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Abstract. Background. Vitamin D deficiency is present in over half of population worldwide. It has been long known that vitamin D deficiency contributes to the development of osteopenia and osteoporosis. As the vitamin D receptors are present in all human cells, several studies have focused on the extra-skeletal effects of vitamin D and the way it affects general health of patients. The purpose of the study was to assess some risk factors of vitamin D deficiency among Ukrainian women in Carpathian region. **Materials and methods.** Four hundred and ninety-five women aged 18–82 years were included in this cross-sectional study from 2014 to 2016. Serum 25-hydroxyvitamin D levels were measured in all participants after collecting their demographic and anthropometric data and past medical histories. **Results.** The prevalence of vitamin D deficiency and insufficiency was 91.1 %. Analysis of logistic regression shows that age (odds ratio (OR): 0.98, confidence interval (CI): 0.95–0.98) and menopause (OR: 0.49, CI: 0.25–0.98) were independent predictive factors for vitamin D deficiency. **Conclusions.** This study showed a high prevalence of vitamin D deficiency among Ukrainian women, especially in reproductive age.

Keywords: vitamin D deficiency and insufficiency; women; risk factors; Ukraine

Introduction

The literature published over the two last decades indicates increasing awareness of pleiotropic, multidirectional action of vitamin D in the human body. Evidence from large-scale studies contributed to the understanding that vitamin D deficiency may be a significant risk factor for many diseases of civilization [1, 2]. Vitamin D is essential not only in such processes as bone development and muscle function, but also in modulation of the immune system and regulation of cellular differentiation and proliferation, leading to a probable etiologic role of deficiency states in serious diseases like type 1 diabetes mellitus and autoimmune thyroid pathology [3–5]. Several studies indicated that there is a high prevalence of vitamin D deficiency in Ukraine and Central European countries [6, 7]. The figures for suboptimal levels from several countries in this region were reported between 60 and 80 % [8]. In order to evaluate the vitamin D status in Ukraine better, studies involving different populations in various age groups are required. Lack of systematic epidemiological observations on vi-

tamin D deficiency and insufficiency in the population of Ukraine necessitated the further research.

The purpose of this study was to assess some risk factors of vitamin D deficiency among women aged 18–82 years in Carpathian region.

Materials and methods

This cross-sectional study was conducted in Bukovinian State Medical University from 2014 to 2016. The ethics institutional review board of Bukovinian State Medical University approved the study, and informed consent was obtained from all participants. Four hundred and ninety-five women aged 18–82 years were included in this study. Serum 25-hydroxyvitamin D levels were measured in all participants after collecting their demographic and anthropometric data and past medical histories. Deficiency was defined as levels less than 20 ng/ml and vitamin D insufficiency — as 20–30 ng/ml [10].

Exclusion criteria were: chronic illness, history of cancer, pregnancy or lactation, malabsorption syndrome

or gastric disorders, metabolic bone disease, renal or hepatic failure, recent history of therapeutic vitamin D consumption or osteoporosis treatment.

Participants filled in a questionnaire which included anthropometric and demographic data, past medical history, parity and menopausal status, as well as drug histories.

Body mass index (BMI) was calculated based on self-reported body height and weight. Menopause was defined according to the patient's report if menstruation had stopped at least 12 months ago.

25(OH)D levels were evaluated by electrochemiluminescent method and test-systems cobas. This is considered to be the most highly-sensitive method which allows for very precise evaluation within a wide range of possible research samples.

Statistical analysis of the research data was done using the software package Statistica 10.0. Data presentation corresponded to their distribution: in normal distribution (Lilliefors test), the data were presented as mean values \pm standard deviation ($M \pm SD$), in others variants — as median (Me) and interquartile range [LQ–UQ]. In the normal distribution to test our hypothesis about the equality of two groups' averages, we used a Student's t-test (t). Statistical significance of variables between groups was analyzed using Kruskal-Wallis test, Mann-Whitney test and χ^2 test. A multilinear regression analysis was performed to evaluate the association between serum 25(OH)D (dependent variable) and age, BMI and menopausal status (independent variable). The null hypothesis was rejected at $p < 0.05$ for each of the tests.

Results

A total of 495 women were included in the study. The mean age of patients was 43.7 ± 1.3 years and their average BMI — 28.2 ± 4.5 kg/m².

The median level of 25(OH)D in all women was 23.0 ± 7.7 ng/ml. Vitamin D level less than 30 ng/ml was detected in 451 of participants, the prevalence of vitamin D deficiency was 91.1 %; insufficiency was detected in 288 persons (58.2 %), deficiency — in 163 (32.9 %), and severe deficiency — in 31 women (6.7 %).

Only 8.9 % of the Ukrainian women were found to have normal 25(OH)D values whereas 58.2 % were diagnosed with vitamin D insufficiency, and 32.9 % — with vitamin D deficiency. It must be noted that severe vitamin D deficiency (25(OH)D level below 10 ng/ml) was registered in 6.7 % of subjects.

Based upon the assessment of 25(OH)D levels in each age group, it was found that a group of young adults had a significantly higher level of 25(OH)D than those aged 35–44 years ($p < 0.01$), 60–74 years ($p < 0.05$), 75 years and older ($p < 0.05$). The lowest 25(OH)D was registered in the age group of 35–44 years. It was significantly lower than in the age groups of 45–59 and 60–74 years ($p < 0.05$), as compared to the subjects aged 20–34 years ($p < 0.01$).

All variables were separately included into the univariable logistic model and were compared between vitamin D sufficiency and vitamin D deficiency group. The crude odds ratio (OR) of each was obtained (Table 1). The variables with p -value less than 20 % were included in the multivariate logistic model. A total of 3 variables with p -value < 20 % that were previously studied in univariate model were entered in the multivariate logistic model: age, BMI and menopausal status.

In the univariable model, vitamin D deficiency showed a significant inverse association with age, BMI and menopause (Table 1). A total of 495 samples were examined in this study and 3 variables were entered into logistic models. All remaining variables in the final model were: age (adjusted OR = 1.48); BMI (adjusted

Table 1. Correlation of vitamin D deficiency with principal characteristics: adjusted and unadjusted results (multivariable and univariable model)

Variable	Crude OR	Adjusted OR
Age		
OR	0.93	0.98
95% CI	0.91–0.97	0.95–0.99
p	0.005	0.025
Menopause		
OR	0.28	0.49
95% CI	0.18–0.46	0.25–0.98
p	0.005	0.035
BMI, kg/m²		
OR	0.82	0.94
95% CI	0.83–0.97	0.85–1.03
p	0.03	0.08

OR = 89 %); menopausal status (adjusted OR = 37 %). BMI, age and menopausal status were independent predictive factors for vitamin D deficiency.

Discussion

Little published information is available regarding epidemiological data on vitamin D status in the large geographical region of Central Europe [6, 9]. The recent studies have demonstrated that D hypovitaminosis is extremely common in various regions around the world. The territory of Ukraine covers several latitudes, thus, cholecalciferol synthesis turns out to be somewhat different when comparing one region to another.

A low serum vitamin D level (below 30 ng/ml) is a worldwide predicament ranging from 30 to over 80 % in various populations [10, 11]. Recent studies show that this problem is not limited to sun-deprived areas of the world but is also common in sunny regions such as Florida (USA), Turkey, Australia, India, Israel, etc. [4, 12].

Our study has found that a significant proportion of Ukrainian population has suboptimal vitamin D serum levels, and 91.1 % are vitamin D deficient. This figure is slightly higher than the European average data which indicate the vitamin D deficiency in 2 to 30 % of the adult population, but is close to the results of Romanian authors who confirm the presence of vitamin D deficiency in 86.1 % [13]. Traditionally, population that is considered at risk of vitamin D deficiency is the elderly, especially postmenopausal women. But some of the recent studies demonstrate the lack of a clear age gradient in vitamin D insufficiency and deficiency occurrence [14].

In this study, we observed almost the same trend: the total vitamin D deficiency prevalence in the population was high ranging from minimal in the age group 20–34 years to maximum in older than 75 years group. We consider it can be due to vitamin D lowering in the younger general population.

This study deals with vitamin D status in women. We have some limitations in our work; detailed diet habits of the participants as well as rates of sun exposure were not considered in the method because of practical difficulties. On the other hand, blood samples were taken regardless of season or weather conditions whereas this could influence the serum vitamin D levels. The weight and height were self-reported in more than half of cases as well.

This study shows a very high prevalence of vitamin D deficiency in a sample of Ukrainian women, especially those of reproductive age. We would recommend supplementing daily foods with vitamin D and encouraging women to spend more time in direct sunlight.

Conclusions

Only 8.9 % of the Ukrainian women were found to have normal 25(OH)D values whereas 58.2 % were diagnosed with vitamin D insufficiency, and 32.9 % — with vitamin D deficiency. It must be noted that severe vitamin D deficiency was registered in 6.7 % of the subjects.

Significantly higher 25(OH)D level was registered in younger age group (20–34 years) as compared to other age groups.

BMI, age and menopausal status were independent predictive factors for vitamin D deficiency.

Conflicts of interests. Author declares the absence of any conflicts of interests that might be construed to influence the results or interpretation of their manuscript.

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Факторы риска дефицита витамина D среди украинских женщин в Карпатском регионе

Резюме. Актуальность. Дефицит витамина D отмечается более чем у половины населения во всем мире. Давно известно, что дефицит витамина D приводит к развитию остеопении и остеопороза. Поскольку рецепторы витамина D присутствуют во всех клетках организма, в исследованиях последних лет основное внимание уделяется внескелетным эффектам витамина D и влиянию на общее состояние здоровья. Целью исследования было оценить некоторые факторы риска дефицита витамина D среди украинских женщин в Карпатском регионе. **Материалы и методы.** В исследовании с 2014 по 2016 г. приняли участие 495 женщин в возрасте 18–82 лет. Уровни сывороточного 25-гидроксивитамина D были измерены у всех участников

после изучения их демографических и антропометрических данных и медицинского анамнеза. **Результаты.** Распространенность дефицита и недостаточности витамина D в женской популяции Карпатского региона составила 91,1 %. Анализ логистической регрессии показал, что возраст (отношение шансов (ОШ): 0,98, доверительный интервал (ДИ): 0,95–0,98) и менопауза (ОШ: 0,49, ДИ: 0,25–0,98) были независимыми предикторами дефицита витамина D. **Выводы.** В исследовании показана высокая распространенность дефицита витамина D среди украинских женщин, особенно в репродуктивном возрасте.

Ключевые слова: дефицит и недостаточность витамина D; женщины; факторы риска; Украина

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Факторы риска дефицита витамина D среди украинских женщин в Карпатском регионе

Резюме. Актуальність. Дефіцит вітаміну D присутній більше ніж у половини населення в усьому світі. Відомо, що дефіцит вітаміну D призводить до розвитку остеопенії та остеопорозу. Оскільки рецептори вітаміну D є у всіх клітинах організму, у дослідженнях останніх років основну увагу було приділено позаскелетним ефектам вітаміну D та впливу на загальний стан здоров'я. Метою дослідження було оцінити деякі фактори ризику дефіциту вітаміну D серед українських жінок у Карпатському регіоні. **Матеріали та методи.** У дослідженні з 2014 по 2016 р. взяли участь 495 жінок віком 18–82 роки. Рівні сироваткового 25-гидроксивітаміну D були виміряні у всіх учасників піс-

ля вивчення їх демографічних і антропометричних даних та медичного анамнезу. **Результати.** Поширеність дефіциту та недостатності вітаміну D у жіночій популяції Карпатського регіону становила 91,1 %. Аналіз логістичної регресії показав, що вік (відношення шансів (ВШ): 0,98, довірчий інтервал (ДІ): 0,95–0,98) та менопауза (ВШ: 0,49; ДІ: 0,25–0,98) були незалежними предикторами дефіциту вітаміну D. **Висновки.** У дослідженні показано високу поширеність дефіциту вітаміну D серед українських жінок, особливо в репродуктивному віці.

Ключові слова: дефіцит та недостатність вітаміну D; жінки; фактори ризику; Україна