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VITAMIN D STATUS IN OUTPATIENTS ATTENDING THE CENTER OF ENDOCRINOLOGY*

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Over the last decade, vitamin D insufficiency and deficiency are increasingly diagnosed in persons attending outpatient centers [1, 2]. Vitamin D status has been connected with disadvantageous health results [3]. Recently, the influence of vitamin D insufficiency and deficiency on various cardiovascular, autoimmune, infectious and oncological diseases has been established [4]. There are about billion people worldwide who have vitamin D insufficiency or deficiency [5, 6]. It is known that the level of availability of vitamin D depends on many factors (region of residence, nutrition, intensity of insolation, racial characteristics, genetic determinants, the presence of diseases affecting the synthesis of vitamin D, as well as the intake of certain drugs) [7, 8].

Despite the study of these factors and the possibility of their correction, low levels of vitamin D are equally common in both the northern and southern regions, both in men and women, both in children and adults [9].

The lack of uniform diagnostic criteria and standardized methods for assessing the level of 25(OH)D in serum determines a large scatter of data indicating the level of the population provision with vitamin D [10]. The most frequently used diagnostic criteria are recommendations from the International Society of Endocrinologists [11].

Insufficiency and deficiency of vitamin D are common among the Ukrainian population. However, the results of the vitamin D status in the population of Ukraine are limited.

The aim of this study was to estimate the prevalence of vitamin D insufficiency and deficiency in outpatients of endocrinology center.

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The authors guarantee responsibility for everything published in the article, as well as the absence of a conflict of interest and their own financial interest in performing the work and writing an article.

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MATERIALS AND METHODS

This cross-sectional study was conducted at the Ukrainian Research and Scientific Centre of Endocrine Surgery, Transplantation of Endocrine Organs and Tissues, Health Ministry of Ukraine. Consecutive patients attending outpatient department were invited to participate in this study. Patients aged from 18 to 79 years who attended this center were eligible to participate. Written informed consent was obtained, and then participants were subjected to clinical and laboratory investigations. All patients were asked about their usage of supplements, improving vitamin D status. Authors did the study during summer months (July, August).

We have assembled information on age, gender, and prevailing symptoms and known medical disorders such as diabetes mellitus (DM), obesity and arterial hypertension (AH). We have also examined for symptoms such as weakness, laziness, muscle aches, and bony pain. Then, general and systemic clinical examination was done on every patient. After obtaining written consent, 3 ml of blood sample was collected by phlebotomy in dry glass test tube and was transferred in cool-box to the laboratory of D.F. Chebotarev Institute of Gerontology of the National Academy of Medical Sciences of Ukraine, Kyiv. Institutional ethical committee clearance was taken for the study (protocol 27; 30.03.2020).

The term «Vitamin D» refers to compound Vitamin D_3 (cholecalciferol). Vitamin D_3 level in serum was estimated by electrochemiluminescence on cobas elecsys 411 fully automated system. Vitamin D deficiency was defined as 25(OH)D < 20 ng/ml, insufficiency as 20–29 ng/ml and sufficiency as ≥ 30 ng/ml [11].

Sampling and statistical analysis

Required sample size to estimate the prevalence of 50% Vitamin D deficiency with 95% confidence interval (CI) of 46–54% was 800. Final sample size with 10% nonresponse rate was 810. All analyses were performed using Epi-Info 7, CDC, Atlanta, GA, USA. Categorical variables were presented as numbers. Numerical variables were summarized as mean and standard deviation when normally distributed whereas median with inter-quartile range when nonnormally distributed.

Table 1.

Distribution of outpatients who visited the endocrinology center

Variable	n	%
Age group, years		
< 30	79	9.8
31–45	257	31.7
46–60	284	35.1
> 61	190	23.4
Gender		
Female	526	64.9
Male	284	35.1
The place of residence above sea level, m		
200–350	388	47.9
351–700	307	37.9
> 701	115	14.2
The place of residence in the radiation-polluted area	126	15.6
Type 2 DM	75	9.3
Arterial hypertension	289	35.7

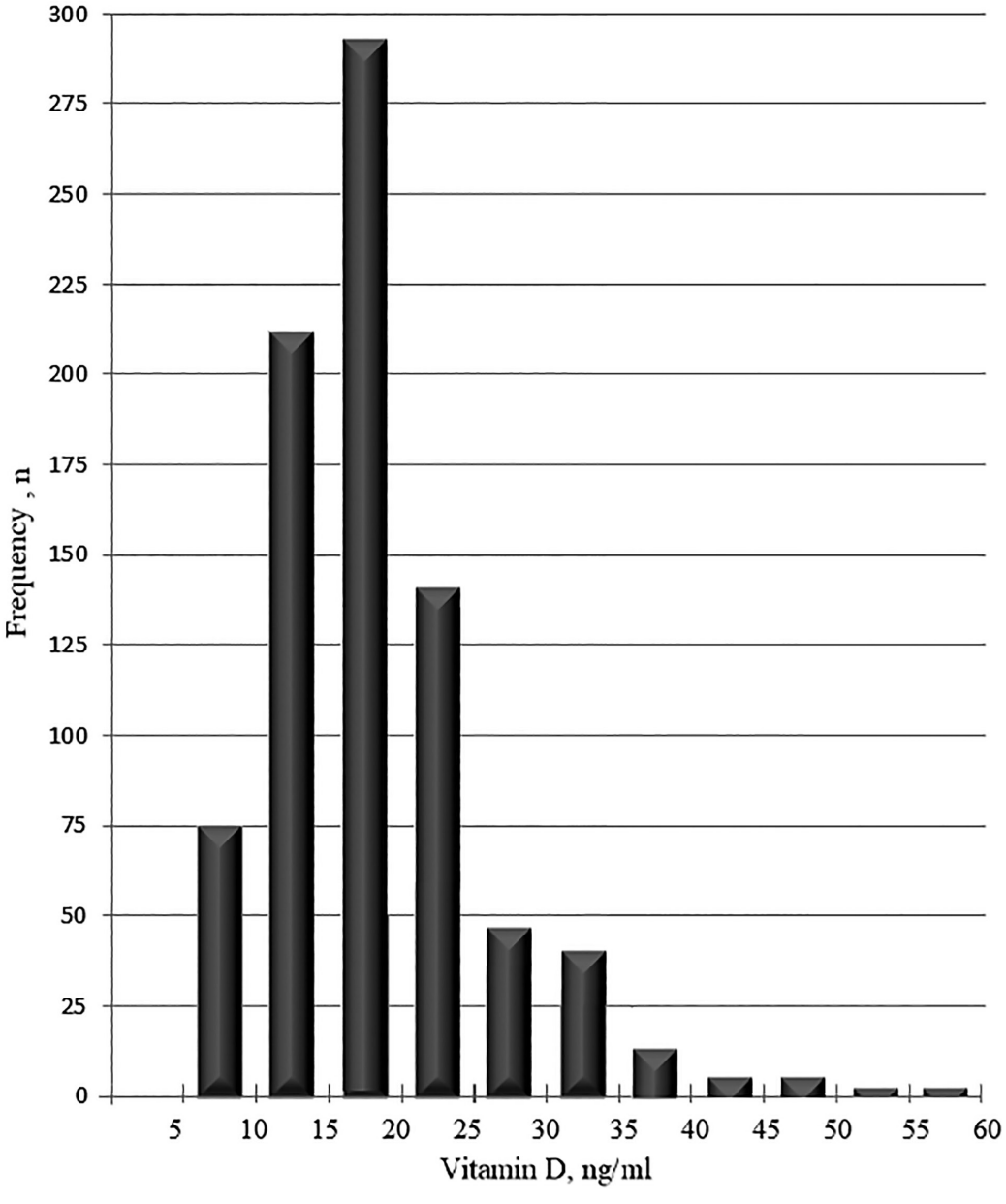

Figure 1. Distribution of Vitamin D levels.

Prevalence of deficiency was reported as proportion with 95% CI. Comparison of Vitamin D levels across groups was conducted using Mann–Whitney or Kruskal–Wallis tests. Multiple linear regression analysis was used where Vitamin D level was represented as dependent variable and presence of type 2 DM, AH, age, gender, the place of residence above the sea level, in the radiation-polluted area were represented as independent variables. Categorical variables were fake coded as 0 — No and 1 — Yes for this purpose. $P < 0.05$ was considered statistically significant.

RESULTS AND THEIR DISCUSSION

In total, 810 participants were enrolled in the study. Mean age was 48.1 years (standard deviation 17.2) which included participants from minimum of 18 years of age to maximum of 78 years. Distribution of participants by their gender, complexion, and disease status among various categories of vitamin D level is shown in Table 1.

Average vitamin D level was 19.43 ng/ml with a standard deviation of 5.08 and was non-

Table 2.

Distribution of participants as per Vitamin D level and demographic and clinical features

Variables	Observations	Mean	SD	25th CI	Median	75th CI	p
Age group, years							
19–30	79	14.2	1.7	8.2	13.5	18.5	0.02
31–45	257	19.3	3.1	10.2	14.1	21.9	
46–60	284	20.1	2.7	11.0	17.7	22.8	
> 61	190	20.4	2.6	15.5	16.2	23.2	
Gender							
Male	284	18.7	2.8	11.2	16.1	22.0	0.54
Female	526	20.1	3.1	9.4	15.2	23.3	
Type 2 DM							
No	735	19.6	2.9	10.2	15.7	23.1	0.57
Yes	75	18.6	2.5	10.4	14.5	23.3	
Arterial hypertension							
No	521	20.3	3.2	10.5	16.2	23.3	0.32
Yes	289	18.5	2.4	9.4	15.3	22.8	
The place of residence above sea level, m							
200–350	388	17.9	1.7	10.4	13.9	19.7	
361–700	307	18.3	1.6	10.7	14.4	20.3	
> 700	115	24.1	1.9	15.6	18.8	27.2	0.04
The place of residence in the radiation-polluted area							
No	684	19.8	2.3	10.5	16.7	21.8	
Yes	126	14.2	1.4	8.1	13.2	18.9	0.02

Table 3.

Results of multiple linear regression

Variable	Coefficient	85% CI	p
Age	0.03	– 0.02 — 0.08	0.14
Gender (2/1)	– 0.35	– 1.82 — 1.34	0.79
Type 2 DM (yes/no)	– 2.84	– 4.87 — – 0.76	0.004
Arterial hypertension (yes/no)	– 1.37	– 3.05 — 0.38	0.16
The place of residence in the radiation-polluted area (yes/no)	– 6,08	– 9.11 — – 3.84	0.0001
Constant	10.60	9.02 — 14.68	< 0.0001

normally distributed (figure 1). Vitamin D median was 15.17 ng/ml (25th percentile 10.20; 75th percentile 23.10), min. level 6.20 ng/ml, max. level 59.7 ng/ml.

Vitamin D deficiency (< 20 ng/ml) was observed in 569 (70.2% 95% CI: 63.4–73.8) and insufficiency (20–29.9 ng/ml) was observed in 189 (23.3%) persons.

We compared vitamin D level across age group, gender, age, the place of residence above the sea level, in the radiation-polluted area by using Kruskal-Wallis or Mann-Whitney tests appropriately.

It is evident from table 2 that Vitamin D levels were significantly lower in age group below 30 years, those who have the place of resi-

dence above the sea level (200–350 m), and in the radiation-polluted area.

We have performed multiple linear regression analyses where vitamin-D level was dependent variable and age group, gender, the place of residence in the radiation-polluted area were independent variables. Statistically significant predictors of vitamin D level were presence of type 2 DM, the place of residence in the radiation-polluted area (Table 3).

To the best of our knowledge, current study is the first evaluation of vitamin D deficiency among outpatients of Ukrainian centre of endocrinology. Our study shows a high prevalence of vitamin D deficiency and insufficiency among outpatients of endocrinology centre. Under the supervision of 810 persons, it was found that the incidence of insufficiency (30-20 ng/ml) and deficiency (< 20 ng/ml) of vitamin D was 93.6% at 95% confidence interval 61.2–69.7% In the univariate analysis, vitamin D levels were statistically significantly lower in the younger age group. After multiple linear regression analysis of the residence in the radiation-polluted area, the presence of type 2 diabetes mellitus was identified as statistically significant predictors of the development of vitamin D deficiency.

Studies of the Chernobyl accident s consequences hows its impact on the health of survivors, since a quite high level of premature mortality in population of radiologically contaminated areas [12]. A relationship between the content of 25(OH)D and mortality (from all causes, cardiovascular and oncopathology) in the general population (26,018 men and women) aged 50–79 years was reviewed in meta-analysis [13]. At the same time, a special attention was paid to the age, gender, seasonality and place of residence. It was found that levels of vitamin D differed significantly between the countries with a highest level in the USA and northern Europe. It was also different depending on a period of the year (higher rates were in the summer) and gender (higher rates in men). The 6,695 people died during the observation, of which 2,624 due to cardiovascular disease and 2,227 from cancer. Establishing a reliable relationship between the 25(OH)D level and magnitude of mortality from all causes, in particular from cardiovascular disese and cancer was the most important conclusion of the study. Clinical studies confirm that vitamin D plays a key role in modulating the immune responses in various inflammatory and autoimmune diseases [14]. The vitamin D level is in a negative correlation with insulin resistance [15]. Recently, the study of vitamin D deficiency in adults was conducted in Ukraine [16–18], but data from individuals living in areas of radiological contamination were not analyzed there.

No data on the content of vitamin D in people living in radioactive contaminated areas is available in the accessible literature. Only in few papers, the protective effect of vitamin D under a low intensity radiation exposure is reported. For example, D.P. Hayes has stated that calcitriol is involved in the life cycle of cells, and also activates the vitamin D receptors that provide an immune response. These receptors, in turn, contribute to the production of proteins that protect against radiation exposure [19].

An experimental study in rats has shown that prolonged exposure to radioactive cesium (137Cs) significantly reduces the activity of vitamin D metabolism and leads to molecular modifications of enzymes (cytochromes P450) involved in metabolism of vitamin D in liver and brain [20]. Therefore, the study of the vitamin D supply to population of radiologically contaminated territories is a topical issue.

CONCLUSIONS

The incidence of vitamin D deficiency (< 20 ng/ml) was observed in 569 (70.2% 95% CI: 63.4–73.8) and insufficiency (20–29.9 ng/ml) was observed in 189 (23.3%) persons. In the univariate analysis, vitamin D levels were statistically significantly lower in the younger age group and in excessive body weight. After multiple linear regression analysis the place of residence in the radiation-polluted area, the presence of type 2 diabetes mellitus were identified as statistically significant predictors of the vitamin D deficiency development. Therefore, such people should be examined for the content of vitamin D in serum.

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Background. Deficiency of vitamin D are common among the Ukrainian population. However, the results of the vitamin D status in the population of Ukraine are limited.

The aim of the study – to evaluate the vitamin D levels in persons attending outpatient department of the center of endocrinology.

Materials and methods. A cross-sectional study was conducted in outpatients who visited the endocrinology center. After obtaining informed consent, we collected information about the examined adults and conducted a blood sampling to determine 25(OH)D level using the electrochemiluminescence method on the fully automated cobas elecys E411 system. Vitamin D content was compared in different groups using the Mann–Whitney or Kruskal–Wallis tests and a multiple linear regression analysis was conducted to detect promoters that affect vitamin D levels.

Results. 810 paf were under the cup, it was found that the incidence of vitamin D deficiency (< 20 ng/ml) was observed in 569 (70.2% 95% CI: 63.4–73.8) and insufficiency (20–29.9 ng/ml) was observed in 189 (23.3%) persons. In the univariate analysis, vitamin D levels were statistically significantly lower in the younger age group and in excessive body weight. After multiple linear regression analysis the place of residence in the radiation-polluted area, the presence of type 2 diabetes mellitus were identified as statistically significant predictors of the development of vitamin D deficiency.

Conclusion. We have identified a high incidence of vitamin D insufficiency and deficiency in patients attending the endocrinology center. After multiple linear regression analysis the place of residence in the radiation-polluted area, the presence of type 2 diabetes mellitus were identified as statistically significant predictors of the development of vitamin D deficiency. Therefore, such people should be examined for the content of vitamin D in serum.

Keywords: vitamin D status, predictors of the development of vitamin D deficiency.

ВМІСТ ВІТАМІНУ D В АМБУЛАТОРНИХ ПАЦІЄНТІВ ЕНДОКРИНОЛОГІЧНОГО ЦЕНТРУ

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Дефіцит вітаміну D є поширеним явищем серед населення України. Однак результати стосовно стану забезпечення вітаміном D в українській популяції обмежені.

Мета дослідження — оцінити рівень вітаміну D у осіб, які відвідують поліклінічне відділення ендокринологічного центру.

Матеріали і методи. Проведено порехресне дослідження в амбулаторних хворих, які відвідували ендокринологічний центр. Після отримання інформованої згоди отримана інформація про обстежених осіб та проведений забір крові для визначення рівня 25(OH)D за допомогою методу електрохемілюмінесценції на повністю автоматизованій системі cobas elecys E411. Вміст вітаміну D порівнювали в різних групах за допомогою тестів Манна–Уїтні або Крускала–Уолліса, а також проводили багаторазовий лінійний регресійний аналіз для виявлення предикторів, що впливають на рівень вітаміну D.

Результати. Під спостереженням перебувало 810 пацієнтів. Встановлено, що частота дефіциту вітаміну D (< 20 нг/мл) спостерігалася у 569 (70,2% 95% ДІ: 63,4–73,8), а недостатність (20–29,9 нг/мл) — у 189 (23,3%) осіб. При однофакторному аналізі рівень вітаміну D був статистично достовірно нижчим у молодшій віковій групі та в осіб з надмірною масою тіла. Після багаторазового лінійного регресійного аналізу місце проживання в радіаційно забрудненій місцевості, наявність цукрового діабету 2 типу були визначені як статистично значущі предиктори розвитку дефіциту вітаміну D.

Висновки. Встановлено високу частоту недостатності та дефіциту вітаміну D у пацієнтів, які відвідують ендокринологічний центр. Після багаторазового лінійного регресійного аналізу місце проживання в забрудненій радіацією місцевості, наявність цукрового діабету 2 типу були визначені як статистично значущі предиктори розвитку дефіциту вітаміну D. Тому таким особам рекомендується визначати вміст вітаміну D у сироватці крові.

Ключові слова: статус вітаміну D, предиктори розвитку дефіциту вітаміну D.