Связь между ожирением и уровнем витамина D у женщин в постменопаузальном периоде.

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Резюме:

Актуальность: недостаточность и дефицит витамина D - глобальная проблема XXI века. Не менее актуален вопрос избыточного веса и ожирения во всем мире. Согласно обзору литературы, пациенты с ожирением имеют более низкий уровень витамина D. Эти два фактора повышают риск развития десятков заболеваний и должны контролироваться.

Цели и задачи: изучение уровня 25-гидроксивитамина D в зависимости от индекса массы тела (ИМТ) у женщин в постменопаузальном периоде.

Материалы и методы: в отделении клинической физиологии и патологии опорно-двигательного аппарата, ГУ «Институт геронтологии Национальной Академии Наук Украины» обследовали 1007 женщин, 50-89 лет (средний возраст 65,74 ± 8,61 лет). У пациентов определяли уровень 25-гидроксивитамина D, вес, рост и индекс массы тела (ИМТ). В зависимости от ИМТ все женщины были разделены на 6 групп. I группа состояла из 338 женщин с нормальной массой тела. Во II группе было 16 женщин с недостаточной массой тела. III группу составили 382 женщины с избыточным весом. В следующих двух группах IV и V было соответственно 199 женщин с ожирением I степени и 60 женщин с ожирением II степени, а в группе VI - 12 женщин с ожирением III степени. Уровень 25 (OH) D в сыворотке был определен методом электрохемилюминесцентного анализа - анализатором Elecsys 2010 (Roche Diagnostics, Германия) и тест-системой cobas.

Результаты: 34,4% обследованных женщин имели дефицит витамина D и 31,4% недостаточность. Значительно более низкий уровень 25 (OH) D имели женщины с ожирением I степени - 23,60 ± 10,24 нг/мл и ожирением II степени - 22,38 ± 10,34 нг/мл по сравнению с женщинами с нормальной массой тела - 28,24 ± 12,99 нг/мл (p = 0,00003).У женщин с ожирением ИМТ достоверно влияет на уровень витамина D но это влияние не зависит от сезона.

Ключевые слова: ожирение, дефицит витамина D, недостаточность витамина D, индекс массы тела, женщины в постменопаузе, возраст.

The relationship between obesity and vitamin D levels in postmenopausal women.

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Abstract— Insufficiency and deficiency of vitamin D is global problem of the 21st century. No less urgent a question of overweight and obesity all over the world. According to the literature review patients with obesity have lower level of vitamin D. This two seemingly insignificant factors in fact increased risk of dozens diseases and should be controlled. In the Department of Clinical Physiology and Pathology of the musculoskeletal system, State Institution "Institute of Gerontology NAMS Ukraine" were observed 1007 women, 50-89 years old (the mean age is 65.74±8.61 years old). Patients were detected 25-hydroxyvitamin D level, weight, height and on body mass index (BMI).

Aim: to observe the level of 25-hydroxyvitamin D depending on body mass index (BMI) in postmenopausal women.

Materials and methods: in accordance with their BMI all women were divided into 6 groups. I group consisted of 338 women with normal body weight. In II group were 16 women with insufficient body weight. III group formed 382 women with excessive weight. Next two groups IV and V were 199 women with class I obesity and 60 women with class II obesity and in VI group were 12 women with class III obesity. Serum level of 25(OH)D was tested by electrochemiluminescent method - Elecsys 2010 analyzer (Roche Diagnostics, Germany) and cobas test system.

Results: 34.4% of the examined women have deficiency and 31.4% insufficiency of vitamin D. Significantly lower level of 25 (OH) D had females with class I obesity - 23.60±10.24 ng/ml and class II obesity - 22.38±10.34 ng/ml compared to women with normal body weight - 28.24±12.99 ng/ml (p=0.00003). In women with obesity, BMI has significantly impact on vitamin D level, but does not depend on the season.

Keywords— obesity, vitamin D deficiency, vitamin D insufficiency, body mass index, postmenopausal women, age.

I. INTRODUCTION

BESITY is a chronic complex disease which is manifested by excess accumulation of adipose tissue and is a consequence of an imbalance of consumption and losses. More than 650 million adults in the world suffers from obesity and more than 1.9 billion are overweight.

According to the data of World Health Organization (WHO), in 2016 overweight was detected in 39% of the adult population (39% males and 40% females) and obesity - in 13% (11% males and 15% females). The main factors that promotes development of obesity are: genetic, demographic, socio-economic, psychological, behavioral and neuroendocrine disorders. So the pathogenesis of this disorder is complex but not completely clear. The evidence of epidemiological, genetic and metabolic data emphasized significant role of vitamin D in occurrence of obesity [1]. The

relationship between obesity and level 25(OH)D was examined in numerous studies [1]-[6] but obtained results are contradictory.

According to the data Ministry of Health of Ukraine near 20.1% of population suffers from obesity including 15.9% males population and 25.7% of females. It is prognosed that the numbers of adults with obesity will increase by 2030, up to 49% of men and 6% of women [7]. Vitamin D deficiency (level of vitamin D under 20 ng/ml) in the Ukrainian population was determined in 81.8% of people, vitamin D insufficiency (level of vitamin D within 21–29 ng/ml) – in 13.6% [8], [9]. All the presented data above prompted us to start this investigation.

The aim of this study is to observe the level of 25-hydroxyvitamin D depending on body mass index (BMI) in postmenopausal women.

II. MATERIALS AND METHODS

The study was included 1007 women with menopause (50-89 years old). All patients were treated in the department musculoskeletal disorders at the Department of Clinical Physiology and Pathology of the musculoskeletal system, State Institution "Institute of Gerontology NAMS Ukraine" or consulted in the Ukrainian Scientific-Practical Center for Osteoporosis on out-patient basis.

Mean age of participants was 65.74±8.61 years; Their mean height – 1.61±0.07 m, weight – 70.65±13.50 kg and BMI – 27.27±4.86 kg/m 2. The mean serum level of 25(OH) D– were 26.00±12.00 nmol/l.

Women were divided into 6 groups according to their BMI: I group – 338 women with normal body weight (BMI 18.5-24.9 kg/m^2), II group – 16 women with insufficient weight whose BMI was less than 18.5 kg/m^2, III group – 382 women with excessive body weight (BMI 25.0-29.9 kg/m^2), IV group – 199 women with obesity class I (BMI 30.0-34.9 kg/m^2), V group – 60 women with obesity class II (BMI 35.0-39.9 kg/m^2) and VI group – 12 women with obesity class III (BMI ≥40 kg/m^2). BMI was calculated by a ratio of body weight (in kilograms) and square of height (in meters), expressed in kg/m^2. There were no differences in mean age or height across all groups. Serum level of 25(OH)D was tested by electrochemiluminescent method - Elecsys 2010 analyzer (Roche Diagnostics, Germany) and cobas test system.

Vitamin D level was evaluated according to the latest classification [10]. Vitamin D deficiency diagnosed when serum level of 25(OH)D are lower than 20 ng/ml, vitamin D insufficiency is diagnosed when serum levels of 25(OH)D are between 20 and 30 ng/ml. Normal serum level of 25(OH)D are considered within the range 31-100 ng/ml.

The study results are presented in the following way: M±SD, where M - mean value and SD - standard deviation. We performed a one-way ANOVA test to indicated any differences between group, regression and correlation analysis. If p values were ≤ 0.05 results were considered significant. “Statistika 6.0” © StatSoft, Inc. was used for data processing purposes.

III. RESULTS

The average level of 25(OH)D in all examined women was 26.0±11.9 ng/ml; In a group of 50-59 years - 28.4±12.9 ng/ml; 60-69 years - 28.4±12.9 ng/ml; 70-79 years - 23.5±11.7 ng/ml; 80-89 years -21.8±12.2 ng/ml.Vitamin D deficiency was found in 346 (34.4%) postmenopausal women, deficiency in 316 (31.4%) and normal levels in 346 (34.4%).

The highest level of 25(OH)D was detected in women with normal body weight (28.24±12.99 ng/ml) (table 1),

while the lowest level was revealed in women with class I obesity (23.60±10.24 ng/ml) and class II obesity (22.38±10.34 ng/ml). According to one-way ANOVA analysis, the BMI significantly influenced on 25(OH)D va

lues (F=5.81; p=0.00003).

TABLE I

CLINICAL CHARACTERISTICS AND LEVEL OF 25(OH)D IN EXAMINED PATIENTS DEPENDING ON BODY MASS INDEX

Groups	AGE, YEARS	Height, m	Weight, kg	BMI, kg/m^2	5(OH)D, ng/ml
Normal body weight (n=338)	64.97±8.93	1.62±0.07	59.05±6.08	22.61±1.63	28.24±12.99
Insufficient body weight (n=16)	66.88±9.29	1.63±0.11	45.94±6.10	17.33±1.18	21.53±11.48
Excessive body weight (n=382)	66.33±8.71	1.61±0.07	70.80±7.19	27.36±1.40	26.12±11.76
Obesity of class I (n=199)	65.87±7.83	1.60±0.06	82.57±6.88	32.02±1.36	23.60±10.24
Obesity of class II (n=60)	65.36±8.20	1.61±0.07	94.94±9.28	36.67±1.27	22.38±10.34
Obesity of class III (n=12)	66.58±9.82	1.58±0.06	106.83±12.13	42.79±2.66	23.00±12.70
F	1.04	1.50	558.04	1989.93	6.16
p	0.413	0.202	<0.0001	<0.0001	0.0001

Women in the age group of 50-59 years with normal body weight have a higher vitamin D level than patients with obesity of class I (30.75±12.56 vs 26.30±12.29; p=0.04) and obesity of class II (30.75±12.56 vs 21.31±6.84; p=0.004). We have also detected probable differences in the levels of vitamin D in the age group of 60-69 (28.47±12.43 vs 23.29±9.80; p=0.001) (Table 2).

TABLE II

LEVEL OF VITAMIN D IN EXAMINED PATIENTS DEPENDING ON AGE

Groups	N	25(OH)D, ng/ml	BMI, kg/m^2
Normal body weight	111	30.75±12.56	22.60±1.64
Insufficient body weight	3	23.16±8.86	17.90±0.09
Excessive body weight	94	28.62±12.39	27.29±1.35
Obesity of class I	46	26.30±12.29	32.15±1.48
Obesity of class II	16	21.31±6.84	37.29±1.28
Obesity of class III	4	17.72±9.74	43.62±2.53
F		2.93	566.73
P		0.01	<0.0001
60-69 years			
Normal body weight	128	28.47±12.43	22.79±1.63
Insufficient body weight	8	22.62±14.73	17.53±0.67
Excessive body weight	153	27.28±10.99	27.30±1.42
Obesity of class I	90	23.29±9.80	32.05±1.37
Obesity of class II	28	25.50±10.49	36.49±1.23
Obesity of class III	3	27.56±20.54	42.40±1.91
F		2.59	789.77
p		0.02	<0.0001
70-79 years			
Normal body weight	82	25.94±13.42	22.41±1.55
Insufficient body weight	3	18.99±8.77	15.97±2.31
Excessive body weight	111	23.09±11.77	27.43±1.42
Obesity of class I	54	22.30±9.05	31.88±1.18
Obesity of class II	11	16.56±4.95	36.71±1.22
Obesity of class III	4	24.32±12.38	42.84±3.76
F		1.74	501.72
p		0.13	<0.0001

80-89 years			
Normal body weight	17	21.38±14.48	22.34±1.93
Insufficient body weight	2	18.49±9.59	17.68±0.14
Excessive body weight	24	22.91±10.95	27.55±1.48
Obesity of class I	9	20.59±8.20	31.88±1.67
Obesity of class II	5	21.16±20.68	35.60±0.61
Obesity of class III	1	25.09±0.00	40.44±0.00
F		0.09	101.83
P		0.99	<0.0001

Correlation and regression analyses of relations between 25(OH)D and BMI are shown in Fig. 1 and Table 3.

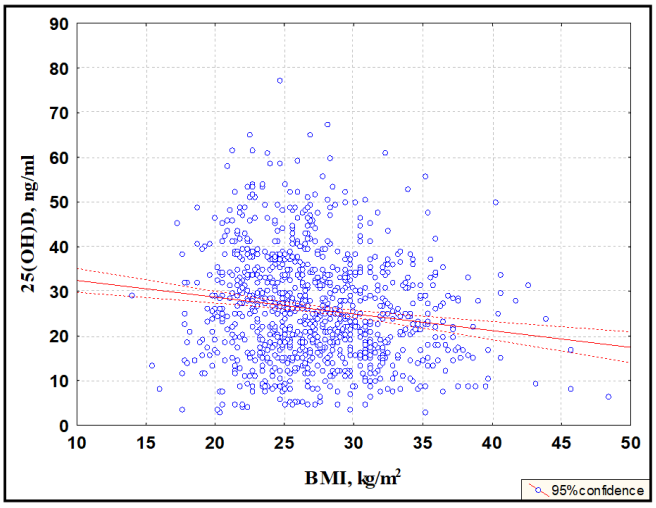


Fig.1. Correlation between 25(OH)D level and BMI: 25(OH)D (ng/ml) = 28.9 – 0.06×BMI (kg/m^2) – r=0.15; t=4.88; p=0.000001.

The highest correlation coefficient between the 25(OH)D levels and BMI was observed in women of 50-59 years (r=-0.22; p=0.0002). Regression analysis of relation between 25(OH)D levels and BMI is shown in Table III.

TABLE III

LINEAR REGRESSION EQUATION FOR CALCULATING 25(OH)D LEVELS DEPENDING ON BODY MASS INDEX

Age group	Linear regression equation	n	r	t	p
50-59	25(OH)D level = 42.91 - 0.54*BMI, kg/m^2	274	-0.22	-3.73	0.0002
60-69	25(OH)D level = 34.89 - 0.30*BMI, kg/m^2	410	-0.13	-2.57	0.01
70-79	25(OH)D level = 34.04 - 0.39*BMI, kg/m^2	265	-0.16	-2.57	0.01
80-89	25(OH)D level = 18.81 + 0.11*BMI, kg/m^2	58	0.05	0.34	0.73

Notes: n – number of patients; r – correlation coefficient; t – Student criterion.

The distribution of patients according to the level of vitamin D depending on BMI is presented in the Table IV.

χ^2 showed a significant difference between normal levels of vitamin D in patients with normal body weight and obesity of class I (χ^2= 13.9; p=0.002) and obesity of class II (χ^2= 12.2; p=0.005).

TABLE IV

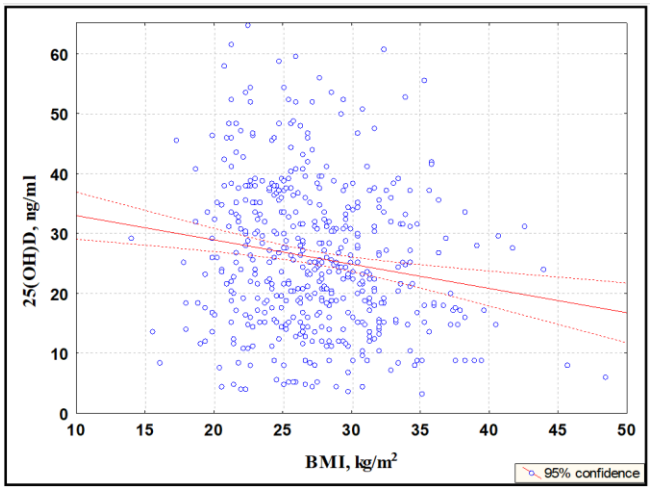
DISTRIBUTION OF PATIENTS ACCORDING TO THE 25(OH)D LEVELS DEPENDING ON BODY MASS INDEX

Groups	n	Normal	Deficiency	Insufficiency
Normal body weight	338	142 (42.0%)	96 (28.4%)	100 (29.6%)
Insufficient body weight	16	4 (25.0%)	4 (25.0%)	8 (50.0%)
Excessive body weight	382	133 (34.8%)	125 (32.7%)	124 (32.5%)
Obesity of class I	199	52 (26.1%)	67 (33.7%)	80 (40.2%)
Obesity of class II	60	11 (18.3%)	20 (33.3%)	29 (48.4%)
Obesity of class III	12	3 (25.0%)	4 (33.3%)	5 (42.7%)

Patients were also divided into two groups depending on season: winter-spring – serum 25(OH)D was

determined in Nov 1 to April 30; summer-autumn – May 1 to Oct 31. Correlation and regression analysis of 25(OH)D and BMI are shown in Fig. 2 and Table V. We detected a probable effect of BMI on the level of vitamin D in the winter-spring and summer-autumn periods.

A



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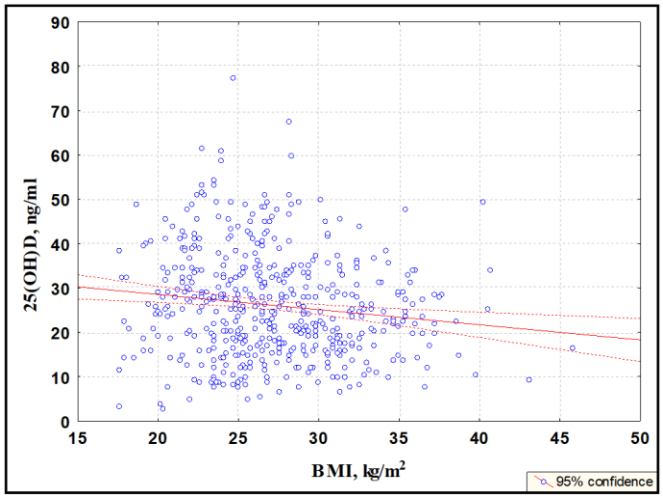

Fig. 2 Correlation between level of 25(OH)D in the winter-spring (A) and summer-autumn (B) periods

Note. Linear regression equations:

A – 25(OH)D level = 37.00 - 0.40*BMI, kg/m2 (r=-0.16; p<0.0003);

B – 25(OH)D level = 35.40 - 0.34*BMI, kg/m2 (r=-0.14; p<0.001).

TABLE V

25(OH)D LEVELS DEPENDING ON SEASON

Groups	n	Age, years	BMI, kg/m^2	25(OH)D, ng/ml
winter-spring				
Normal body weight	160	64.15±8.33	22.54±1.64	28.25±13.03
Insufficient body weight	7	71.29±8.42	16.62±1.53	22.00±12.57
Excessive body weight	188	65.40±8.20	27.42±1.38	25.99±12.20
Obesity of class I	99	66.23±7.49	31.97±1.37	24.05±10.99
Obesity of class II	29	66.07±9.28	36.94±1.37	21.10±12.24
Obesity of class III	7	65.29±10.75	43.34±2.90	20.20±10.40
F		1.68	990.21	2.97
p		0.132	<0.0001	0.001
summer-autum				
Normal body weight	178	65.71±9.41	22.68±1.63	28.25±13.00
Insufficient body weight	9	63.44±8.85	17.87±0.29	21.17±11.33
Excessive body weight	194	67.22±9.10	27.30±1.42	26.25±11.36
Obesity of class I	100	65.52±8.18	32.07±1.35	23.15±9.47
Obesity of class II	31	64.71±7.13	36.42±1.13	23.58±8.19
Obesity of class III	5	68.40±9.21	42.03±2.36	26.92±15.76
F		1.13	974.66	3.19
P		0.340	<0.0001	0.007

IV. DISCUSSION

It is known from the literature that vitamin D deficiency is present in most obese patients and should be considered as it contributing factor.

According to a study conducted at the Metabolic and Medical Lifestyle Management Clinic in Oslo, Norway, 2126 patients were examined and a serum level of 25 (OH) D was determined. Seasonal variation of 25 (OH) D level were compared with BMI, sex, and age of the examinated persons. It has been found that in both males and females, regardless of age, increasing BMI is assosiating with decrease level of 25 (OH) D . It was detected significant negative correlation between BMI and serum 25 (OH) D level. The deficiency of vitamin D level more often was observed among patients with BMI ≥ 40: in 32% of women and 46% of men [14]. The results of this study confirm that serum 25 (OH) D level and its seasonal variations depend on BMI.

In A. McGill et al. research was evaluated the relationship between vitamin D level and different types of obesity. In outpatients department were examined 250 patients with a BMI 28 to 50 . According to the results, 40% of patients had metabolic syndrome and 5% had diabetes type 2. The inverse correlation was found between vitamin D3 and body weight (r = –0.21, p = 0.0009), vitamin D3 and BMI (r = –0.18, p = 0.005), vitamin D3, and waist circumference (r = –0.14, p = 0.03). Serum vitamin D3 level were independent of sex, age, and severity of metabolic syndrome components except waist circumference. Multiple regression analysis showed that with increasing BMI by 1 kg / m2 there is a decrease in serum vitamin D3 of 0.74 nmol / l, while increasing the waist circumference by 1 cm, the level of vitamin D3 in serum decreases by 0.29 nmol / l [15]. Thus, the degree of obesity determined by BMI and waist circumference were parameters associated with vitamin D3 deficiency.

W. Gouda et al., in their research evaluated the level of 25 (OH) D in obese patients and examined its relationship with anthropometric parameters. Researchers have been detected that body mass index and sex are predictors of vitamin D levels. Patients with obesity had significantly lower 25 (OH) D level and 49.3% of obese patients, (mostly women) had it

deficiency. A significant negative correlation was found between BMI and level 25 (OH) D [11].

In the research of Swiss scientists was determined the relationship between vitamin D and body structure. They examined 271 patients, aged over 60 years old, and divided them into quartiles according to level 25 (OH) D. Patients with the lowest quartile (level 25 (OH) D 4.7–17.5 ng / ml) had a higher fat mass (9.3 kg / m2) compared with third quartile patients (8.40 kg / m2; Q3 = 26.1 –34.8 ng / ml) and the highest quartile (8.37 kg / m2; Q4 = 34.9–62.5 ng / ml) ($p = 0.03$). The main idea is that decreasing of 25 (OH) D level may be associated with a biggerer mass of adipose tissue, regardless of BMI [12].

In order to study the effect of obesity on 25 (OH) D level in Ecuador citicen, 2270 participants were included, with the average age 71.5 years old. The prevalence of obesity was detected in 19.2% of patients, and 25 (OH) D deficiency in 14% of men and 34.6% of women. Moreover, the ammount of women with 25 (OH) D deficiency remained stable regardless of BMI. In contrast, 25 (OH) D deficiency in men increased gradually the increasing of BMI. Older men with obesity (OR 2.04; 95% confidence interval (CI) 1.99–2.09) were twice as likely to have deficient of vitamin D compared to men with normal body weight. In women, this relationship is weaker. However, the prevalence of vitamin D deficiency remained 12% higher in obese women (OR 1.12; 95% CI 1.11–1.14) compared to women with normal body weight. According to the study, the author recommends to adults with obesity to take vitamin D supplements, to modificate their lifestyles and to maintain within normal rates 25 (OH) D level [13].

Our findings are consistent with previous studies showing that obesity and overweight have adversely affect on vitamin 25 (OH) D level.

V. Conclusion

In Ukrainian postmenopausal woman with obesity were detected significantly impact BMI on vitamin D level, but the results does not depend on the season..Vitamin D deficiency was detected in 34.4% of woman, insufficiency in 31,4% normal level in 34.4%. 25(OH) D levels were significantly lower in women with obesity of class I (23.60±10.24 ng/ml) and obesity of class II (22.38±10.34 ng/ml), compared with women who had normal body weight (28.24±12.99 ng/ml). obesity had a negative effect on 25 (OH) D level. The study results revealed a weak correlation between 25(OH)D level and BMI ($r=0.15$). The presented results should be taken into account for prevention and treatment of vitamin D deficiency in obese women.

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