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AGE-RELATED DYNAMICS OF BONE MINERAL DENSITY IN THE ADULT POPULATION OF YAKUTSK

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ABSTRACT. There has been conducted a study of the age dynamics and characteristics of the of the bone mineral density (BMD) in the adult population of the Yakutsk city. There have been revealed the BMD maximum age rates in both women (aged between 40 and 49 years old) and men (aged between 60 and 69 years old). The first 10 years after menopause onset in women, BMD decreases by 18%. The correlation of body mass index and BMD depending on gender and ethnicity was revealed.

Keywords: bone mineral density, osteoporosis, body mass index, menopause.

Relevance. Yakutsk is acknowledged to be the largest city of central Yakutia. The climatic and geographical features of the location are known to be accompanied by a low level of insolation and a long winter period of 6-9 months per year [3, 4].

A low level of insolation is stated to lead to a deficiency in the synthesis of vitamin D, which in turn appears to be a trigger in the development of osteoporosis [7].

Osteoporosis is accepted to be one of the most common diseases which have been given a leading position in the structure of morbidity and mortality in the world [1, 6].

According to the International Osteoporosis Foundation, more than 200 million people worldwide have been suffering from osteoporosis. In Russia, the number of patients with osteoporosis is estimated to be about 14 million. The tendency to increase the life expectancy of the population is admitted to result in an increase in the incidence of osteoporosis in postmenopausal women, as well as in men, in the older age group [12, 17].

Women are known to have a higher risk of developing osteoporosis. This is supposed to be due to the peculiarities of the hormonal status; during the onset of menopause, the process of bone resorption is acknowledged to be accelerated, the volume of bone mass is stated to decrease, whereas the risk of fractures is accepted to increase [11].

The severity of osteoporosis is known to be caused by the presence of low-energy fractures one of which appears to be a fracture of the proximal femur including the femoral neck fracture. Some epidemiological studies which have been conducted in a number of Russian cities have revealed significant differences in the prevalence of proximal femur fractures in a population over 50 years of age. On average, the incidence of proximal femur fractures among residents in the Russian Federation has been accessed to be 174.7 for men and 267.5 for women for 100 thousand people [18].

According to the undertaken multi-site epidemiological study, the incidence of fractures of the proximal femur in Yakutsk has been estimated to be 216.64 per 100 thousand people [8].

Considering that Yakutia has its climatic and geographical features (which are low insolation, type of nutrition, long winter period, remoteness of settlements, their inaccessibility), the need to study the problem of osteoporosis and its complications is supposed to be viewed as relevant both for the Republic of Sakha (Yakutia) and for Russia in general.

Objective: to identify the age and gender features of the dynamics of bone mineral density in the adult population of the city of Yakutsk.

Materials and methods: During the period of 2016-2017, in the Clinic of the Medical Institute of North-Eastern Federal University named after M.K. Ammosov Yakutsk, X-ray densitometry was performed in 868 patients. The analysis included data on 776 people aged 20 years and older, of which 22.7% were men and 79.3% were women. The distribution by nationality is as follows: in most cases, there were investigated Yakuts (76%) and Russians (20%), whereas there were also examined 4% of patients of other nationalities. The survey was conducted on an X-ray axial densitometer Lunar GE iDXA (USA) with the study of the BMD in the lumbar spine L1-L4 (g/cm^2) [13]. BMD was evaluated according to the WHO criteria (1970): in postmenopausal women and in men over 50 years old, the norm is T-test + 2.5-0.9 of standard deviations; osteopenia is -1.0 – -2.4 of standard deviations: osteoporosis is T-criterion -2.5 and below. In women before menopause and in men younger than 50 years, the Z-test was evaluated [14].

In addition, there was calculated the body mass index, BMI according to WHO, 2004 (18.50-24.99 is a normal weight, 25.00-29.99 is overweight, ≥30.00 is obesity, 30.00-34.99 is the 1st degree, 35.00-39.99 – the 2nd degree, ≥40.00 – the 3rd degree) [15].

Apart from that, there was indicated the hormonal status of women and the presence of menopause (absence of the menstrual cycle after 12 months), distinguishing between an early menopause up to 40–45 years old and a timely menopause at 46–54 years old [10].

In the course of collecting the history, there was revealed the presence of low-energy fractures (falling from the own height) as a risk factor for osteoporosis [11].

Checking the normality of the distribution of quantitative variables was implemented using Kolmogorov-Smirnov, Shapiro-Wilk with the amendment of Lilio-Fords. The descriptive statistics were presented in the form of Median (Me) and interval distribution (Q_1; Q_3). In the course of comparing independent groups, the Kruskal-Wallis test was used. To assess the strength of the direction of the relationship between the variables, the Spearman rank analysis was used. The level of the statistical significance of differences was compared to p = 0.05.

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Table 1

Distribution of the patients on gender and age, n (%)

Age, years	Total	Men	Women
20-29	17 (2.19)	4 (0.5)	13 (1.7)
30-39	25 (3.23)	9 (1.2)	11 (1.6)
40-49	77 (9.92)	22 (2.8)	55 (7.1)
50-59	222 (28.62)	56 (7.3)	166 (21.4)
60-69	319 (41.11)	64 (8.3)	255 (32.9)
70-79	100 (12.87)	18 (2.3)	82 (10.6)
80-87	16 (2.06)	4 (0.5)	14 (1.8)

Results and discussion of the research

We have investigated 776 people: 176 men (22.7%) and 601 women (79.3%) of the medium age of 59.0±1.0 (Table 1).

The maximum frequency of the examined patients has been witnessed in the age group of 50-79 years old, which comprises 82%. A decrease in bone mineral density is more often detected in women after menopause and in the age group over 70 years, regardless of gender [9, 10].

One of the risk factors for osteoporosis in women is considered to be early menopause [20]. Early menopause occurred in 10% of the surveyed women.

The formation of peak bone mass, as well as the general processes of bone tissue remodeling in men and women are acknowledged to differ [2].

The bone mineral density in women after menopause (40-49) during the first 10 years has been estimated to decrease by 18% (0.113 g/sm^2). BMD in men aged 60-69 years old has been witnessed to reach its maximum indexes and to decrease to 4% in the next decade (Fig. 1).

In accordance with the results of the undertaken research [5], the high body mass index is accepted to be associated with the mineral density of the bone tissue.

There have been revealed a direct tight correlation between BMI and BMD in men (p = 0.714) and a reverse correlation in women (p = -0.277) (Table 2).

Despite the great experience which has been gained, the results of the research by many authors are likely to be viewed as contradictory [16, 19].

The mineralization of the bone tissue in Russians has been assessed to be 13% higher than that in Yakuts. Low-energy fractures are seen to have occurred in Yakuts 4 times as often.

The ratio of fractures in men and women has not appeared to depend on the nationality and has been 1:3 respectively.

The frequency of fractures is proved to depend on the age, in the age group of 50 years and older (low-energy) fractures are likely to occur more common than in younger age groups (95% CI from 1.07 to 1.13). Most fractures – up to 83% –have been witnessed in women.

The history of low-energy fractures is known to be more common in the older age group [2].

Conclusion. Therefore, the mineralization of the bone tissue in women is admitted to reach its peak values in women aged 40-49 years old and in men aged 60-69 years old. The first 10 years after the onset of the menopause, the bone mineral density in women is accepted to reduce by 18%. BMI is proved to have a reverse correlation with the bone mineral density in women (p = -0.277) and a direct tight correlation in men (p = 0.714).

Table 2

The rates of the BMD g/sm^2 and the body mass index (BMI) kg/m^2 in men and women of various age groups

Age, years	BMD, g/sm^2	BMI, kg/m^2
Men		
20-29	1.1 (0.9; 1.2)	25.32
30-39	1.0 (0.9;1.6)	25.39
40-49	1.1 (1.0;1.2)	25.93
50-59	1.1 (1.1;1.2)	28.31
60-69	1.2 (1.1;1.3)	29.18
70-79	1.1 (1.0;1.3)	26.91
80-87	1.1 (0.9;1.2)	27.7
p	<0.001	<0.001
Women		
20-29	1.0 (0.9;1.2)	19.72
30-39	1.1 (1.0;1.2)	24.78
40-49	1.1 (1.1;1.2)	26.94
50-59	1.0 (0.9;1.1)	29.33
60-69	0.9 (0.9;1.0)	29.65
70-79	0.8 (0.8;0.9)	28.67
80-86	0.8 (0.7;1.1)	26.16
p	>0.001	>0.001

Note: the data is presented in the format of Me (Q_1; Q3)

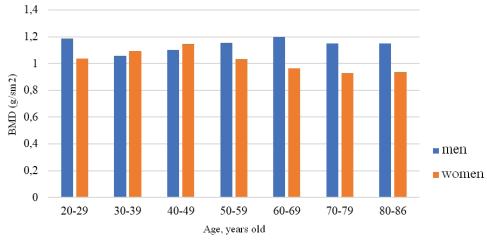

Fig.1. The mineral density of the bone tissue in men and women (g/sm^2) of various age groups

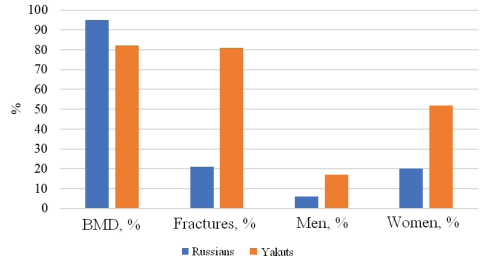

Fig.2. Comparison of BMI, BMD, and low-energy fractures based on the gender and nationality

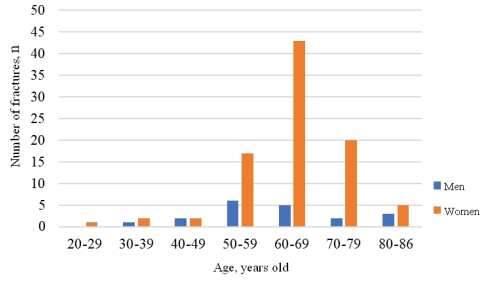

Fig.3. The rate of low-energy fractures based in the age ranks and gender (n, %)

The mineralization of the bone tissue in Yakuts has been estimated to be 13% lower than that in the Russians, and, hence, the number of low-energy fractures in them is assessed to be 4 times as high. The ratio of fractures in men and women has not been revealed to depend on the nationality.

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