

государственной статистики; 2017. [Demograficheskii ezhegodnik Rossii. 2017. M.: Izdatel'stvo Federal'noi sluzhby gosudarstvennoi statistiki; 2017. (In Russ.).]

6. Малишевская Н.П., Соколова А.В., Демидов Л.В. Современное состояние заболеваемости меланомой кожи в Российской Федерации и федеральных округах. *Медицинский совет*. 2018;10:161-165. [Malishevskaya NP, Sokolova AV, Demidov LV. The incidence of skin melanoma in the Russian Federation and federal districts. *Meditsinskii sovet*. 2018;10:161-165. (In Russ.).] DOI: 10.21518/2079-701X-2018-10-161-165.

7. Мордовский Э.А., Соловьев А.Г., Санников А.Л. Социально-демографический и алкогольный статус умерших от новообразований в трудоспособном и в пожилом возрасте. *Наркология*. 2016;15(2):13-19. [Mordovsky EA, Soloviev AG, Sannikov AL. Socio-demographic and alcoholic status died of tumors in the working-age and in old age. *Narkologiya*. 2016;15(2):13-19. (In Russ.).]

8. Рубцова Ю.В., Мордовский Э.А., Потехина Е.Ф., Гладилина С.В. Динамика заболеваемости и причины поздней диагностики рака желудка у населения Архангельской области в 2006 – 2015 гг. *Российский онкологический журнал*. 2017;22(6):329-335. [Rubtsova YV, Mordovsky EA, Potehina EF, Gladilina SV. Dynamics of incidence rate and causes of the late diagnosis of gastric cancer in the Arkhangelsk region in 2006-2015. *Rossiiskii onkologicheskii zhurnal*. 2017;22(6):329-335. (In Russ.).] DOI: 10.18821/1028-9984-2017-22-6-329-334

9. *Состояние онкологической помощи населению России в 2016 году*. Под ред. Каприна А.Д., Старинского В.В., Петровой Г.В. М.: Издательство Московского научно-исследовательского онкологического института имени П.А. Герцена; 2016. [Kaprin AD, Starinskii VV., Petrova GV, eds. *Sostoyanie onkologicheskoi pomoshchi naseleniyu Rossii v 2016 godu*. M.: Izdatel'stvo Moskovskogo nauchno-issledovatel'skogo onkologicheskogo instituta imeni P.A. Gertsena; 2016. (In Russ.).]

10. Указ Президента Российской Федерации №1351 от 09.10.2007 г. «Об утверждении Концепции демографической политики Российской Федерации на период до 2025 года». Ссылка активна на 01.03.2019. [Ukaz Prezidenta Rossiiskoi Federatsii №1351 ot 09.10.2007 g. «Ob utverzhdenii Kontseptsii demograficheskoi politiki Rossiiskoi Federatsii na period do 2025 goda». (In Russ.).] http://www.consultant.ru/document/cons_doc_AW_176737a46cb13de731db-3333fcd77a4f7887e468287e3/.

11. Указ Президента Российской Федерации №598 от 07.05.2012 г. «О совершенствовании государственной политики в сфере здравоохранения». Ссылка активна на 01.03.2019. [Ukaz Prezidenta Rossiiskoi Federatsii №598 ot 07.05.2012 g. «O sovershenstvovanii gosudarstvennoi politiki v sfere zdravookhraneniya». (In Russ.).] <https://rg.ru/2012/05/09/zdorovje-dok.html>.

12. Указ Президента Российской Федерации №683 от 31.12.2015 г. «О Стратегии национальной безопасности Российской Федерации». Ссылка активна на 01.03.2019.

[Ukaz Prezidenta Rossiiskoi Federatsii №683 ot 31.12.2015 g. «O Strategii natsional'noi bezopasnosti Rossiiskoi Federatsii». (In Russ.).] http://www.consultant.ru/document/cons_doc_LAW_191669/.

13. Указ Президента Российской Федерации №214 от 07.05.2018 г. «О национальных целях и стратегических задачах развития Российской Федерации на период до 2024 года». Ссылка активна на 01.03.2019. [Ukaz Prezidenta Rossiiskoi Federatsii №214 ot 07.05.2018 g. «O natsional'nykh tselyakh i strategicheskikh zadachakh razvitiya Rossiiskoi Federatsii na period do 2024 goda». (In Russ.).] <https://rg.ru/2018/05/08/president-ukaz204-site-dok.html>.

14. Чернышев А.В. Пути повышения эффективности государственных федеральных программ в снижении смертности населения от управляемых причин. *Вестник Тамбовского университета. Серия Естественные и технические науки*. 2013;18(5-3):2899-2901. [Chernyshev AV. Ways to improve the effectiveness of federal government programs in reducing mortality from controllable causes. *Vestnik Tambovskogo universiteta. Seriya Estestvennye i tekhnicheskije nauki*. 2013;18(5-3):2899-2901. (In Russ.).]

15. Miller AJ, Mihm MC Jr. Melanoma. *New England Journal of Medicine*. 2006;355(1):51-65. DOI: 10.1056/NEJMra052166.

16. Stewart BW, Kleihues P, eds. *World Cancer Report*. Lyon: IARC Press; 2003.

17. Szklo M., Nieto F.J. *Epidemiology: beyond the basics*. 3rd ed. Burlington : Jones & Bartlett Learning; 2012.

DOI 10.25789/YMJ.2019.68.26

УДК 616.71-003.84

V.V. Epanov, A.A. Epanova, O.N. Kolosova, A.P. Borisova MINERAL DENSITY OF BONE TISSUE OF THE AXIAL SKELETON IN POSTMENOPAUSAL WOMEN WITH OVERWEIGHT

The study evaluated the relationship between obesity and mineral bone density (BMD) of the axial skeleton in postmenopausal period of women living in the conditions of Yakutia. It was revealed that the body mass index statistically significantly affects the mineral density of bone tissue, while the ratio of muscle tissue to adipose tissue is very important. The increased mineralization of the bone tissue of the axial skeleton in postmenopausal women directly depends on the degree of obesity.

Keywords: bone density, obesity, composite body composition.

Introduction. The postmenopausal period is characterized by a decrease in female sex hormones, leading to a change in metabolic processes in the body, which in further causes the occurrence of metabolic disorders and may become the basis of metabolic diseases, such as osteoporosis, obesity [3]. Both diseases can be present simultaneously in one patient, repeatedly enhancing its pathological effect, which is one of the reasons for the high level morbidity and mortality [8].

Osteoporosis (OD) refers to multifactorial metabolic diseases. a skeleton characterized by a decrease in bone mineral density (BMD) and violation of its microarchitectonics, causing deterioration of bone strength and high

risk of fractures [5]. Currently, OP is one of the main reasons of disability, reduced quality of life and premature mortality of the elderly people [1]. The main risk factors and causes of metabolic disorders in the bone tissues are: a decrease in the level of sex hormones, female gender, insufficient body weight, fractures in parents, insufficient or excessive physical activity, the presence of concomitant diseases and the use of drugs that affect bone the cloth. Female gender is one of the risk factors for osteoporosis, since onset of menopause, they lose bone mass from 0.86 to 1.21% per year, unlike males from 0.04 to 0.90% [5]. Adipose tissue consists of adipocytes, is a variety of connective tissue and performs heat-insulating in

the body, energy, endocrine function [4]. With obesity, excessive accumulation of subcutaneous and visceral fat. In the postmenopausal period, more than 50% of women begin to develop obesity or it progresses [7,9,22]. After menopause, as a result of decrease in female sex hormones becomes most noticeable accumulation of visceral fat (abdominal obesity). Also during this period 25–40% of women develop OP [9,27]. Adipose tissue performing endocrine function, may affect bone tissue alone or through adipokine production [9]. Using the dual-energy X-ray method absorptiometry has made it possible to selectively measure the amount of mineral, fat and lean mass and explore the relationship between body components in recent years [2].

Results of studies on the relationship between fat and bone fabrics are quite controversial. According to a number of studies, obesity can lead to an increase in bone mineral density (BMD) due to a higher level of estradiol and increased mechanical stress [10,11, 18,19, 24]. Other studies show that excess fat mass cannot protect a person from osteoporosis, and an increase in adipose tissue leads to a decrease in BMD, since an increase in visceral fat is associated with higher levels of pro-inflammatory cytokines, which increase the activation of osteoclasts, which, in turn, in turn, leads to an increase in bone resorption and, consequently, to a decrease in BMD [13,14,16,17,25]. Premaor M. et al. In their study showed a significant increase in the risk of hip fracture in postmenopausal women with obesity [20]. Today there is growing evidence that with visceral obesity and metabolic syndrome, bone tissue becomes even more fragile, causing an increased risk of low-energy fractures [19]. The results of biochemical studies reveal lower rates of bone formation in obese women [11]. It is believed that increased body fat inhibits the formation of new collagen structures. With the discovery of bone marrow obesity, researchers focused on the role of adipocytes in the bone marrow and their effect on bone formation and the development of osteoporosis [8]. To date, the question of the effect of adipose tissue on bone mineral density remains ambiguous and requires further study.

The purpose of this study is to study the relationship between the degree of obesity and bone mineral density (BMD) in women in postmenopausal period living in Yakutia.

Materials and methods: In a one-shot observational study, a simple random sample involved 147 women in postmenopausal period living in Yakutsk with a body mass index (BMI) > 25, which corresponded to overweight (World Health Organization, 1997). The average age of the subjects was 61 ± 6.6 years, the period in menopause was 14 ± 6.8 years. All patients were divided into 4 groups by type of obesity: group I - pre-obesity (BMI = 27.39 ± 1.3 ; n = 64); Group II - obesity I Art. (BMI = 32.21 ± 1.5 ; n = 52); Group III - obesity II tbsp. (BMI = 36.71 ± 1.2 ; n = 24); Group IV - obesity III tbsp. (BMI = 43.67 ± 1.8 ; n=7). Research was carried out in compliance with ethical standards (opinion of the ethics committee, protocol No.7 of September 12, 2016). All subjects received voluntary written consent to participate in the survey. Exclusion

criteria were refusal to participate in the examination, all clinical manifestations of atherosclerosis, endocrine diseases accompanied by overweight, diseases that cause secondary osteoporosis, malignant diseases, taking drugs that affect bone and fat metabolism.

The examination was performed on a GE Lunar iDXA X-ray axial densitometer (USA). We had analyzed (AP Spine) BMD for L1–4 (g/cm²), (Dual Femur) femoral neck, evaluated the T-criterion (comparison with normal peak bone mass) and the total amount of minerals (g). To determine the composite composition of the body (the absolute and relative amount of fat, muscle and bone tissue), the program (Body Composition) was used.

To process the research data, we used the package of statistical processing of experimental data on MS Excel and the statistical program Stat Soft STATISTICA Automated Neural Networks 10 for Windows Ru. Verification of the laws of normal distribution was done using the Kolmogorov-Smirnov criterion. To identify the relationship between the studied parameters, a Pearson correlation analysis (r) was performed. Comparison of two independent groups in quantitative terms with a normal distribution of values was carried out using the modified Student criterion. Statistically significant results are recognized at $p < 0.05$.

The results of the study. BMD in the lumbar vertebrae (segments L1-L4) in women with obesity in the postmenopausal period was higher than in women with obesity (Pic. 1). A direct correlation was obtained ($r = 0.60$) between BMD and body mass index (BMI). The highest BMD was found in women of group IV ($p < 0.001$).

The study of the composite composition of the body of women was carried out in all groups, where fat and muscle mass were separately considered (Pic.2). The results obtained indicate that with obesity of I and II degree, the ratio of adipose tissue to muscle, equal to 0.86, is the same as in women with obesity (group I). In group IV, with III degree obesity, the proportion of adipose tissue exceeds muscle tissue and their ratio becomes more than unity (1.04). A statistically significant decrease in muscle mass in group IV, compared with other

groups, is not an isolated process, but occurs with the simultaneous accumulation of fat mass (Pic. 2). The proportion of adipose tissue in total body weight in women with grade III obesity (group IV) was significantly higher than in women in all other groups ($p < 0.001$).

In women with grade III obesity, a statistically significant positive relationship was found between BMI, BMD of the lumbar spine and adipose tissue mass ($r = 0.61$), and a negative correlation between BMI and muscle mass ($r = -0.57$) (Pic.3).

Examination of women revealed asymmetry of the BMD in the left and right femoral neck (Pic. 4). BMD in the left femoral neck in all groups of examined

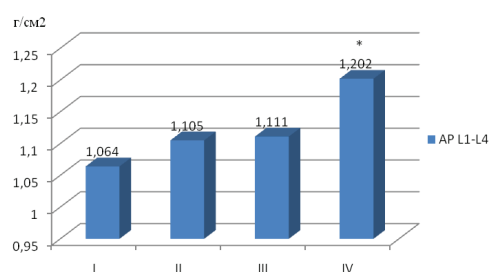


Fig. 1. Mineral bone density (BMD; g/cm²) in the lumbar spine (segments L1-L4) in postmenopausal women in groups with different body mass index (BMI)

* significance of differences with group I - $p < 0.0001$; with group II - $p = 0.0039$; with group III - $p < 0.042$

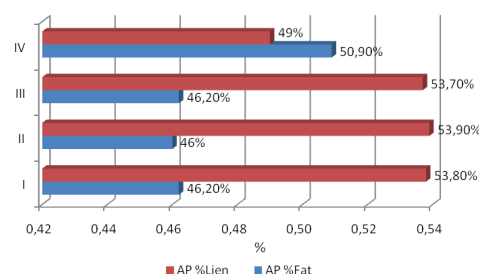


Fig. 2. The ratio of fat (Fat) and muscle mass (Lien) (%) depending on the degree of body mass index

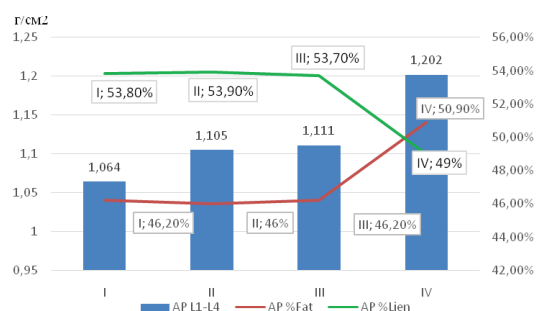


Fig. 3. The ratio of fat (Fat), muscle mass (Lien) (%) and bone mineral density (AR L1-L4) in the lumbar spine in groups

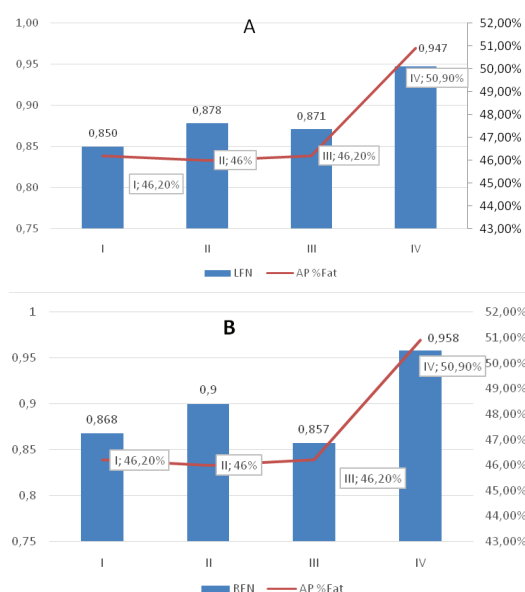


Fig. 4. Bone mineral density of the left (LFN; A), right (RFN; B) neck of the femur and % ratio of fat mass (Fat) in the lumbar spine of women in the postmenopausal period

obese women was higher than in group I (Pic. 4A). In group III, BMD of the right femoral neck was lower than in women with obesity (Pic. 4B).

Women with obesity from group II to group IV is detected an uneven growth in BMD. In group III, bone mineralization in the femoral neck both on the left (LFN) and on the right (RFN) was lower than in group II. When studying BMD in the area of the femoral neck in group IV, a direct statistically significant moderate relationship was found with the mass of adipose tissue ($r = 0.449$) (Pic. 4). With an increase in the body above 50% of the mass of adipose tissue, the BMD increases.

The discussion of the results.

The study of the relationship between the degree of obesity and BMD in postmenopausal women living in the conditions of Yakutia is of particular interest due to the fact that people living in extreme climatic conditions of the North show a high level of psycho-emotional stress, high morbidity and rapid progression of chronic non-infectious diseases, acceleration aging processes, the earlier onset of menopause and a reduction in life expectancy [5].

As a result of studying the relationship between BMI and BMD of the axial skeleton in women in the postmenopausal period living in Yakutia, a direct significant correlation between these indicators was revealed ($r = 0.60$). In the modern literature, information about the relationship between obesity and osteoporosis in women in the

postmenopausal period is quite contradictory [15,16,20-23,25]. This is probably due to the fact that the researchers did not divide the subjects into groups according to the degree of obesity and the results of the study depended on the proportion of individuals with varying degrees of obesity in the sample. Since BMI is associated with obesity, we tried to analyze the relationship between BMD and the degree of obesity. The study of composite body composition in women with abdominal obesity of the first and second degree indicates that the ratio of muscle and adipose tissue does not significantly change in these groups. The highest BMD values were found in women with III degree of obesity ($p < 0.001$), in whom an increase in the proportion of adipose tissue (more than 50%) with a decrease in the proportion of muscle tissue leads to an increase in the mineral density of the spongy bone tissue of the axial skeleton (spine, femoral neck), which can be considered as an adaptive protective reaction of the body.

Since ovaries no longer secrete estrogen in postmenopausal women, extragonadal synthesis of estrogen in adipose tissue becomes the dominant hormone, therefore, during this period, the role of adipocytes as estrogen producers can become quite important for bone metabolism [28]. It is possible that in women with III degree obesity, the revealed positive relationship between adipose tissue and BMD is associated with increased estrogen synthesis in adipose tissue, which may also be one of the potential mechanisms of the body's adaptive protective reaction.

Conclusion. The body mass index statistically significantly affects the mineral density of bone tissue, while the ratio of muscle tissue to adipose tissue is very important. The increased mineralization of the bone tissue of the axial skeleton in postmenopausal women directly depends on the degree of obesity.

The work was performed as a part of the State Assignment "Ensuring the Conduct

References

1. Аметов А.С. Доскина Е.В. Заболевание эндокринной системы и остеопороз. *Русский медицинский журнал*. 2004;17:1022.
2. Ametov AS. Doskina EV. [Endocrine system

disease and osteoporosis]. *Russkij medicinskij zhurnal*. [Russian medical journal]. 2004;17:1022. (In Russ.).

2. Беневоленская Л.И., Лесняк О.М.. Остеопороз: диагностика, профилактика и лечение / под ред. Л.И. Беневоленской, О.М. Лесняк. М., ГЭОТАР – Медиа, 2005. 171 с.

Benevolenskaya LI, Lesnyak OM. [Osteoporosis: diagnosis, prevention and treatment]. М., GEOTAR – Media. [M., GEOTAR – Media]. 2005; 171. (In Russ.).

3. Мисникова И.В., Ковалева Ю.А., Климина Н.А. Саркопеническое ожирение. *Русский медицинский журнал*. 2017;1:24-29.

Misnikova IV, Kovaleva Yu.A, Klimina N.A. [Sarcopenic obesity]. *Sarkopenicheskoe ozhirenie* [Russian Medical Journal]. 2017;1:24-29. (In Russ.).

4. Птичкина П.А., Скрипникова И.А., Новиков В.Е., Метельская В.А. и др. Композитный состав тела, костная масса и адипокины у женщин в постменопаузе с разным кардиоваскулярным риском (SCORE). *Остеопороз и остеопатия*. 2012;1:3-6.

Ptichkina PA, Skripnikova IA, Novikov VE, Metel'skaja VA. [Composite body composition, bone mass and adipokines in postmenopausal women with different cardiovascular risk (SCORE)]. *Osteoporoz i osteopatii*. [Osteoporosis and osteopathy]. 2012;1:3-6. (In Russ.).

5. Хаснулин В.И., Хаснулин П. В. Современные представления о механизмах формирования северного стресса у человека в высоких широтах // *Экология человека*. 2012;1:3-11.

Khasnulin VI, Khasnulin PV. Modern views on the mechanisms of the formation of northern stress in humans at high latitudes. *Ekologiya cheloveka* [Human Ecology]. 2012;1:3-11. (In Russ.).

6. Чигарькова О. В. Состояние костной ткани у женщин с ожирением в постменопаузе. Влияние снижения массы тела на минеральную плотность кости и показатели костного метаболизма: автореф. на соиск. учен. степ. канд. мед. наук (14.00.03) / Чигарькова Ольга Вячеславовна; Федеральное государственное учреждение Эндокринологический научный центр.- Москва, 2009.-22с.

Chigarkova O. V. Bone tissue in postmenopausal obese women. The effect of weight loss on bone mineral density and bone metabolism: avtoref. na soisk. uchen. step. kand. med. nauk (14.00.03) / Chigarkova Od'ga Vyacheslavovna; Federal'noe gosudarstvennoe uchrezhdenie Endokrinologicheskii nauchnyi tsentr [Federal State Institution Endocrinological Research Center]. Moskva, 2009:22.

7. Шишкова В.Н. «Ожирение и остеопороз». *Остеопороз и остеопатия*. 2011;1:21-26.

Shishkova VN. [Obesity and osteoporosis]. *Osteoporoz i osteopatii*. [Osteoporosis and osteopathy]. 2011; 1:21-26. (In Russ.).

8. Baran DT, Faulkner KG, Genant HT. et al. Диагностика и лечение остеопороза принципы использования костной денситометрии. *Остеопороз и остеопатия*. 1998;3:10-16.

Baran DT, Faulkner KG, Genant H.T. et al. *Osteoporoz i osteopatii*. [Osteoporosis and osteopathy]. 1998; 3:10-16. (In Russ.).

9. Blum M, Harris SS, Must A, Naumova EN, Phillips SM, Rand WM, Dawson-Hughes B: Leptin, body composition and bone mineral density in premenopausal women. *Calcif Tissue Int*. 2003;73(1):27-32. doi:10.1007/s00223-002-1019-4. View ArticlePubMedGoogle Scholar

10. Campos R.M., de Piano A, da Silva P.L., Carnier J., et al. The role of pro/anti-inflammatory adipokines on bone metabolism in NAFLD obese adolescents: effects of long-term interdisciplin-

ary therapy. *Endocrine*. 2012;42(1):146-156. doi: 10.1007/s12020-012-9613-3.

11. Felson DT, Zhang Y, Hannan MT, Anderson JJ: Effects of weight and body mass index on bone mineral density in men and women: the Framingham study. *J Bone Miner Res*. 1993;8(5): 567-573. doi: 10.1002/jbmr.5650080507 View ArticlePubMedGoogle Scholar

12. Goulding A, Taylor RW, Jones IE, McAuley KA, Manning PJ, Williams SM: Overweight and obese children have low bone mass and area for their weight. *Int J Obes Relat Metab Disord*. 2000;24(5):627-632. doi:10.1038/sj.ijo.0801207. View ArticlePubMedGoogle Scholar

13. Hofbauer LC, Schoppet M. Clinical implications of the osteoprotegerin/RANKL/RANK system for bone and vascular diseases. *Jama-Journal of the American Medical Association*. 2004;292(4):490-495. doi: 10.1001/jama.292.4.490.

14. Hsu YH, Venners SA, Terwedow HA, Feng Y, Niu T, Li Z, Laird N, Brain JD, Cummings SR, Bouxsein ML, Rosen CJ, Xu X: Relation of body composition, fat mass, and serum lipids to osteoporotic fractures and bone mineral density in Chinese men and women. *Am J Clin Nutr*. 2006; 83 (1): 146-154. doi: 10.1093/ajcn/83.1.146 PubMedGoogle Scholar

15. Nelson LR, Bulun SE. Estrogen production and action//*Journal of the American Academy of Dermatology*. 2001;45(3):116-124. doi: 10.1067/mjd.2001.117432. PubMedGoogle Scholar

16. Ohta H, Ikeda T, Masuzawa T, Makita K, et al. Differences in Axial Bone-Mineral Density, Serum Levels of Sex Steroids, and Bone Metabolism between Postmenopausal and Age-Matched and Body Size-Matched Premenopausal Subjects. *Bone*. 1993;14(2):111-116.

17. Pellemounter MA, Cullen MJ, Baker MB, Hecht R, Winters D, Boone T, & Collins F. Effects of the obese gene-product on body weight regulation in ob/ob mice. *Science* 1995; 269:540-3. doi: 10.1126/science.7624776

18. Poehlman ET. Menopause, energy expenditure, and body composition. *Acta Obstet Gynecol Scand* 2002; 81(7): 603-11. doi: 10.1034/j.1600-0412.2002.810705.x

19. Premaor MO, Pilbrow L, Tonkin C, et al.

Obesity and fractures in postmenopausal women. *J. Bone and Mineral Research*. 2010;25(2):292-7. doi: 10.1359/jbmr.091004

20. Ravn P, Cizza G, Bjarnason NH, Thompson D, Daley M, Wasnich RD, McClung M, Hosking D, Yates AJ, Christiansen C: Low body mass index is an important risk factor for low bone mass and increased bone loss in early postmenopausal women. Early Postmenopausal Intervention Cohort (EPIC) study group. *J Bone Miner Res*. 1999; 14(9):1622-1627. doi:10.1359/jbmr.1999.14.9.1622. View ArticlePubMedGoogle Scholar

21. Reid I.R. Relationships among body mass, its components, and bone. *Bone*. 2002; 31(5):547-555.

22. Reid IR, Evans MC, Ames RW: Volumetric bone density of the lumbar spine is related to fat mass but not lean mass in normal postmenopausal women. *Osteoporos Int*. 1994;4 (6): 362-367. doi: 10.1007/BF01622199. View ArticlePubMedGoogle Scholar

23. Pluijm S.M., Visser M, Smit J.H. et al. Determinants of bone mineral density in older men and women: Body composition as mediator. *J. Bone Miner. Res*. 2001;16(11):2142-2151. doi: 10.1359/jbmr.2001.16.11.2142.

24. Pollock NK, Laing EM, Baile CA, Hamrick MW, Hall DB, Lewis RD: Is adiposity advantageous for bone strength? A peripheral quantitative computed tomography study in late adolescent females. *Am J Clin Nutr*. 2007;86 (5): 1530-1538. doi: 10.1093/ajcn/86.5.1530

25. Robling AG, Castillo AB, Turner CH: Biomechanical and molecular regulation of bone remodeling. Annual review of biomedical engineering. 2006;8:455-498. doi: 10.1146/annurev.bioeng.8.061505.095721. View ArticlePubMedGoogle Scholar

26. Rodrigues A. M., Radominski R. B., Suplicy Hde L., De Almeida S. M., Nicliewicz P. A., Boguszewski C. L. The cerebrospinal fluid/serum leptin ratio during pharmacological therapy for obesity. *J Clin Endocrinol Metab* 2002; 87(4): 1621-6. doi: 10.1210/jcem.87.4.8420.

27. Smith B.J, Lerner M.R., Bu S.Y., Lucas E.A., et al. Systemic bone loss and induction of coronary vessel disease in a rat model of chronic

inflammation//*Bone*. 2006; 38(3):378-386. doi: 10.1016/j.bone.2005.09.008

28. Zhao LJ, Jiang H, Papasian CJ, Maulik D, Drees B, Hamilton J, Deng HW. Correlation of obesity and osteoporosis: effect of fat mass on the determination of osteoporosis. *J. of bone and mineral research*. 2008; 23(1):17-29. doi:10.1359/jbmr.070813/

EPANOV Victor Vladimirovich, candidate of medical sciences, associate professor, head. Laboratory of Osteoporosis, Clinic of the Medical Institute of the Federal State Autonomous Educational Institution of Higher Education "M. K. Ammosov North-Eastern Federal University", Medical Institute, 677027, 27 Oyunsky st., Yakutsk, Ph. +7 (4112) 49-67-65. Mob. + 7(924)177-02-73. Viktor.epanov@mail.ru; **EPANOVA Anastasia Aleksandrovna**, candidate of medical sciences, associate professor of the Department of Hospital Surgery and Radiation Diagnostics of the Medical Institute of the Federal State Autonomous Educational Institution of Higher Education "M. K. Ammosov North-Eastern Federal University", 677027, 27 Oyunsky st., Yakutsk, Ph. +7(4112)49-67-65. Epanova_aa@mail.ru; **KOLOSOVA Olga Nikolaevna**, Doctor of Biological Sciences, Professor Chief Researcher, Laboratory of Ecological and Medical Biochemistry, Biotechnology and Radiobiology, Institute of Biological Problems of Cryolithozone SB RAS, 677007 Republic of Sakha (Yakutia), 41th Lenin ave. Yakutsk. Ph. +7(924)177-29-12. Kololgonik@gmail.com; **BORISOVA Agrafena Pavlovna**, graduate student of the department of public health and healthcare of the Medical Institute of the Federal State Autonomous Educational Institution of Higher Education "M. K. Ammosov North-Eastern Federal University". 677027, 27 Oyunsky st., Yakutsk, Ph. +7(4112)49-67-65. Agusch050690@gmail.com

