

Received: 09 March 2024 / Accepted: 09 June 2024 / Published online: 30 June 2024

DOI 10.34689/SH.2024.26.3.004

UDC 611.018.4-053.8-055.1(574.41)

BONE DENSITY IN MEN LIVING IN THE ABAY REGION OF KAZAKHSTAN

Madina Madiyeva¹, <https://orcid.org/0000-0001-6431-9713>

Daniyar Raissov¹, <https://orcid.org/0000-0002-3872-1263>

Kairat Almisaev¹, <https://orcid.org/0009-0005-6519-2319>

Nurgul Kultumanova¹, <https://orcid.org/0009-0005-2475-2009>

Aray Mukanova¹, <https://orcid.org/0000-0001-5603-0207>

Gulim Ilyasheva¹, <https://orcid.org/0009-0007-5769-6730>

Yevgeniy Lenskiy¹, <https://orcid.org/0009-0004-5845-3675>

Azamat Tlegenov¹, <https://orcid.org/0009-0005-0844-0881>

Azamat Yerlanov¹, <https://orcid.org/0009-0006-0555-5074>

Zhanel Yestayeva¹, <https://orcid.org/0009-0001-3386-9023>

Asemgul Zhakupova¹, <https://orcid.org/0009-0001-3736-9421>

Altynay Zamanbek², <https://orcid.org/0009-0005-2436-8592>

¹ NCJSC «Semey Medical University», Semey, Republic of Kazakhstan;

² City polyclinic №36, Almaty, Republic of Kazakhstan.

Abstract

Actuality. Worldwide prevalence of osteoporosis the age of 50 years and above is 7% in men, lower than the 23% reported for women (Vilaca T. et al, 2022). Osteoporosis is generally considered a female disease, so it is not studied enough in men. **The purpose of our paper** was to determine the prevalence of risk factors for decreased bone mineral density in Kazakh men living in the Abay region, Kazakhstan.

Materials and Methods. Recruitment of study participants was conducted by random sampling. The study group included 77 men aged 18 years and older, living in Abay region of Kazakhstan since birth. All participants had dual energy X-ray absorptiometry (DXA), biochemical blood analysis for calcium, alkaline phosphatase and vitamin D and were interviewed. The questionnaire was designed according to the International Osteoporosis Diagnostic Questionnaire.

Results. 22 men had decreased BMD, with a range of -1.5 SD and below. The mean calcium and alkaline phosphatase values were normal, whereas vitamin D deficiency was 16.2 ng/mL. Objective examination findings revealed an elevated BMI of 26.0 kg/m². The questionnaire revealed several factors described as “affecting bone metabolism”. These factors are such as reduction of height by more than 3 cm after 40 years of age (15.6%), smoking (16.9%), infrequent consumption of food rich in calcium, proteins and vitamins.

Conclusion. The prevalence of low bone density in adult males of the Abay region of Kazakhstan was 28.6%. Based on the data available in the literature on risk factors for osteoporosis in women, it can be noted that the same factors are applicable to the study of osteoporosis in men. The results of our study allow us to make recommendations regarding adequate diet, including the consumption of food rich in calcium, protein and vitamin D, regular physical exercise, walks in the open air and avoiding smoking.

Keywords: male, osteoporosis, risk factors, bone mineral density, dual energy X-ray absorptiometry, vitamin D, calcium, alkaline phosphatase, dual energy X-ray absorptiometry.

Резюме

МИНЕРАЛЬНАЯ ПЛОТНОСТЬ КОСТНОЙ ТКАНИ У МУЖЧИН, ПРОЖИВАЮЩИХ В ОБЛАСТИ АБАЙ КАЗАХСТАНА

Мадина Мадиева¹, <https://orcid.org/0000-0001-6431-9713>

Данияр Раисов¹, <https://orcid.org/0000-0002-3872-1263>

Кайрат Альмисаев¹, <https://orcid.org/0009-0005-6519-2319>

Нургуль Культуманова¹, <https://orcid.org/0009-0005-2475-2009>

Арай Муканова¹, <https://orcid.org/0000-0001-5603-0207>

Гүлім Ильяшева¹, <https://orcid.org/0009-0007-5769-6730>

Евгений Ленский¹, <https://orcid.org/0009-0004-5845-3675>

Азамат Тлегенов¹, <https://orcid.org/0009-0005-0844-0881>

Азамат Ерланов¹, <https://orcid.org/0009-0006-0555-5074>

Жанель Естаева¹, <https://orcid.org/0009-0001-3386-9023>

Асемгуль Жакупова¹, <https://orcid.org/0009-0001-3736-9421>

Алтынай Заманбек², <https://orcid.org/0009-0005-2436-8592>

¹ НАО «Медицинский университет Семей», г. Семей, Республика Казахстан;

² Городская поликлиника № 36, г. Алматы, Республика Казакстан.

Актуальность. В мире распространенность остеопороза у мужчин старше 50 лет составляет 7%, что ниже, чем распространенность 23%, зарегистрированная среди женщин (*Vilaca T. et al, 2022*). Остеопороз обычно считается женским заболеванием, поэтому у мужчин он недостаточно оценен. **Целью нашей публикации** было изучение распространенности и факторов риска снижения минеральной плотности кости у мужчин казахов, проживающих в регионе Абай Казахстана.

Материалы и методы. Набор участников исследования проводился методом случайной выборки. Группа исследования сформирована из 77 мужчин в возрасте от 18 лет и старше, проживающих в регионе Абай с рождения. Всем участникам была проведена двуэнергетическая рентгеновская абсорбциометрия, анализ крови на содержание кальция, щелочной фосфатазы и витамина Д и анкетирование. Вопросы анкеты были разработаны в соответствии с международным опросником по диагностики остеопороза.

Результаты. У 22 мужчин было снижение минеральной плотности кости, диапазон составил от -1.5 SD и ниже. Средний показатель кальция и щелочной фосфатазы соответствовал норме, в то время как, витамина Д - недостаток, и составил - 16.2 нг/мл. Данные объективного осмотра выявили повышенный ИМТ - 26.0 kg/m². Анкетирование выявило несколько факторов, описанных как «влияющие на костный обмен». Это такие факторы, как уменьшение роста более чем на 3 см после 40 лет (15.6%), курение (16.9%), редкое употребление пищи богатой кальцием, белков и витаминами.

Заключение. Распространенность низкой плотности кости у взрослых мужчин Абай региона составила 28.6%. Основываясь на данных литературы о факторах риска развития остеопороза у женщин, можно отметить, что те же факторы применимы к исследованию остеопороза у мужчин. Результаты нашего исследования позволяют сделать рекомендации относительно адекватной диеты, включающей употребление пищи, богатой кальцием, белком и витамином D, регулярных физических упражнений, прогулок на открытом воздухе и избегать курения.

Ключевые слова: мужчины, остеопороз, риск фактор, минеральная плотность кости, витамин Д, кальций, щелочная фосфатаза, рентгеновская остеоденситометрия.

Түйіндеме

ҚАЗАҚСТАННЫҢ АБАЙ АУДАНЫНДА ТҰРАТЫН ЕР АДАМДАРДАҒЫ СҮЙЕКТІНІҢ МИНЕРАЛДЫ ТЫҒЫЗДЫҒЫ

Мадина Мадиева¹, <https://orcid.org/0000-0001-6431-9713>

Данияр Раисов¹, <https://orcid.org/0000-0002-3872-1263>

Кайрат Альмисаев¹, <https://orcid.org/0009-0005-6519-2319>

Нургуль Культуманова¹, <https://orcid.org/0009-0005-2475-2009>

Арай Муканова¹, <https://orcid.org/0000-0001-5603-0207>

Гүлім Ильяшева¹, <https://orcid.org/0009-0007-5769-6730>

Евгений Ленский¹, <https://orcid.org/0009-0004-5845-3675>

Азамат Тлегенов¹, <https://orcid.org/0009-0005-0844-0881>

Азамат Ерланов¹, <https://orcid.org/0009-0006-0555-5074>

Жанель Естаева¹, <https://orcid.org/0009-0001-3386-9023>

Асемгуль Жакупова¹, <https://orcid.org/0009-0001-3736-9421>

Алтынай Заманбек², <https://orcid.org/0009-0005-2436-8592>

¹ «Семей Медицина университеті» КЕАҚ, Семей қ., Қазақстан Республикасы;

² №36 Қалалық емхана, Алматы қ., Қазақстан Республикасы.

Кіріспе. Әлемде 50 жастан асқан ер адамдарда остеопороздың таралуы 7% құрайды, бұл әйелдер арасында тіркелген 23% - дан төмен (*Vilaca T. et al, 2022*). Остеопороз әдетте әйелдер ауруы болып саналады, сондықтан ол ерлерде жеткілікті зерттелмеген. **Біздің жұмыстың мақсаты** - Қазақстандағы Абай ауданында тұратын қазақ ер адамдарында сүйектің минералды тығыздығының төмендеуінің қауіп факторларының таралуын анықтау болды.

Әдістері. Зерттеуге қатысушыларды қабылдау кездейсоқ іріктеу әдісімен жүргізілді. Зерттеу тобы Абай облысында туғаннан тұратын 18 жастан және одан асқан 77 ер адамнан құралған. Барлық қатысушыларға қос

энергия рентгендік абсорбциометриядан, кальций, сілтілі фосфатаза және Д дәрумені үшін қан анализі және сауалнама жүргізілді. Сауалнама халықаралық остеопороз диагностикалық сауалнамасына сәйкес құрастырылған.

Нәтижелер. 22 ер адамда сүйектің минералды тығыздығы төмендеді, диапазоны -1.5 SD және одан төмен болды. Кальций мен сілтілі фосфатазаның орташа көрсеткіші нормаға сәйкес келді, ал Д витаминінің жетіспеушілігі - 16.2 нг / мл. объективті тексеру деректері BMI - 26.0 kg/m² жоғарылағанын анықтады. Сауалнама "сүйек алмасуына әсер ететін" деп сипатталған бірнеше факторларды анықтады. Бұл факторлар 40 жастан кейін бойдың 3 см-ден астам қысқаруы (15,6%), темекі шегу (16,9%), кальцийге, белоктарға және витаминдерге бай тағамдарды сирек қолдану.

Қорытынды. Қазақстанның Абай ауданының ересек ер адамдарында сүйек тығыздығының төмендігінің таралуы 28,6% құрады. Әйелдердегі остеопороздың қауіп факторлары туралы әдебиетте қол жетімді деректерге сүйене отырып, ерлердегі остеопорозды зерттеуге бірдей факторлардың қолданылатынын атап өтуге болады. Біздің зерттеуіміздің нәтижелері кальцийге, ақуызға және Д дәруменіне бай тағамдарды тұтынуды, тұрақты физикалық жаттығуларды, ашық ауада серуендеуді және темекі шегуден бас тартуды қоса алғанда, адекватты диетаға қатысты ұсыныстар жасауға мүмкіндік береді.

Түінді сөздер: ер адам, остеопороз, қауіп факторлары, сүйек минералды тығыздығы, қос энергия рентгендік абсорбциометрия, D витамині, кальций, сілтілі фосфатаза, рентгендік остеоденситометрия.

Для цитирования:

Madiyeva M., Raissov D., Almisaev K., Kultumanova N., Mukanova A., Ilyasheva G., Lenskiy Ye., Tlegenov A., Yerlanov A., Yestayeva Zh., Zhakupova A., Zamanbek A. Bone Density in Men Living in the Abay Region of Kazakhstan // Наука и Здравоохранение. 2024. Т.26 (3). С. 34-39. doi 10.34689/SH.2024.26.3.004

Мадиева М., Раисов Д., Альмисаев К., Культуманова Н., Муканова А., Ильяшева Г., Ленский Е., Тлегенов А., Ерланов А., Естаева Ж., Жакупова А., Заманбек А. Минеральная плотность костной ткани у мужчин, проживающих в области Абай Казахстана // Наука и Здравоохранение [Science & Healthcare]. 2024. Vol.26(3), pp. 34-39. doi 10.34689/SH.2024.26.3.004

Мадиева М., Раисов Д., Альмисаев К., Культуманова Н., Муканова А., Ильяшева Г., Ленский Е., Тлегенов А., Ерланов А., Естаева Ж., Жакупова А., Заманбек А. Қазақстанның Абай ауданында тұратын ер адамдардағы сүйектің минералды тығыздығы // Ғылым және Денсаулық сақтау. 2024. Т.26 (3). Б. 34-39. doi 10.34689/SH.2024.26.3.004

Introduction

The prevalence of osteoporosis is expected to increase gradually with the ageing of the world's population [6]. Since osteoporosis is generally considered a female disease, it is evident that in men having a fracture risk of about 13% at age 50 years, it is even more underestimated [1]. Men with low bone mineral density (BMD, range of osteoporosis) do not always have fractures like women. Between 27% and 45% of fractures in elderly men (older than 50 years) occurred within those with a BMD range of -1.0 SD to -2.0 SD [5]. The prevalence of osteoporosis in men older than 50 years is 7%, which is lower than the prevalence of 23% reported for women [10]. It must be remembered that fractures in men occur about 10 years later than in women, and consequently, because of their older age, men may have more comorbidities, so their mortality rate is about twice that of women. Since a sufficient number of publications have been written on this topic, **the purpose** of our work was to determine the prevalence and risk factors of low bone mineral density in Kazakh men living in the Abay region of Kazakhstan.

Material and methods. *Design.* The study recruitment was conducted by means of the random sampling method. The study group was men aged 18 years and older, living in the Abay region of Kazakhstan since birth.

This study was approved by the Ethical Committee of Semey Medical University (Protocol No.7 dated 07.11.2022). All participants were interviewed and had their BMD measured by means of dual energy X-ray absorptiometry (DXA) at the University Hospital of Semey Medical University (SMU) between July 2023, and February

2024. Each participant's survey data were compared with their bone density scans.

Subjects. The subjects of the study were 77 residents (male) of the Abay region of Kazakh nationality. The inclusion criteria included men over 18 years old without a congenital pathology of musculoskeletal system, who had been living in the Abay region since birth, and who were not in the acute phase of a somatic pathology. The exclusion criteria included men of 18 years old and over 65 years of age, patients with congenital pathology of the musculoskeletal system, residents of other regions of Kazakhstan, residents unwilling to participate in the study and unable to sign the informed consent independently.

Bone Mineral Density Testing, the survey and Analysis Method. The subjects' BMDs were measured using DXA (Osteosys, 2020, Korea;). Additionally, the bone density of lumbar spine in L1-L4 was measured in accordance with guidelines for the recommendation of the International Society for Clinical Densitometry (ISCD) from 2007 [3]. According to the World Health Organization (WHO), osteoporosis is defined based on the following bone density levels: the T-scores and Z-scores: -2.5 SD and below indicates the presence of osteoporosis, from -1.5 SD to -2.4 SD indicates low bone mass, a value equal to or exceeding -1.4 SD is considered normal bone density [13]. The values of bone mineral density were interpreted by a qualified radiologist.

The questionnaire were developed in accordance with the international questionnaire for the diagnosis of osteoporosis and supplemented with questions to obtain demographic information. The questions included BMI, smoking and alcohol consumption, history of previous

fractures, family history, nutrition and physical activity data. Patients were asked about current use of calcium, vitamin D, chronic diseases history and therapies that reduce bone density. Nutrition questions were as follows: "How often do you consume calcium and protein rich foods?". The question on physical activity included the time spent outdoors, and physical activity during the day. The questionnaire were surveyed in a paper format, signing an informed consent form.

Biochemical blood analysis for calcium, alkaline phosphatase and vitamin D was performed in the laboratory

of "Aqua Lab" LLP, Almaty (State License No. 15023085 dated 22.12.2015).

The method of descriptive statistics with calculation of the mean and 95% confidence interval was used. The analyses were performed using IBM SPSS version 22.

Results

Table 1 demonstrates the factors affecting bone metabolism of 77 respondents. We consider that height reduction of more than 3 cm in 15.6% of respondents and smoking in 16.9% is valuable in the prognostic aspect of disease development.

Table 1.

Conditions described as inducing low bone density in men.

Parameter	Respondents participating in the survey	Respondent feedback	
		Yes	No
Medical history			
Family history of osteoporosis	77	7(9.1%)	70(90.9%)
Parents' history of fractures	77	6(7.8%)	71(92.2%)
Frequent falls or fear of falling	77	7 (9.1%)	77(90.9%)
After the age of 40, have you lost more than 3 cm in height	77	12(15.6%)	65(84.4%)
Behavioural risk factors			
Physical activity	77	57(74.0%)	20(26.0%)
Being outdoors	77	69(89.6)	8(10.4%)
Alcohol 3 or more units/day	77	3(3.9%)	74(96.1%)
Current Smoking	77	13(16.9)	64(83.1%)
Chronic diseases			
Hepatitis	77	1(1.3%)	76(98.7%)
Chronic obstructive pulmonary disease (COPD)	77	1 (1.3%)	76 (98.7%)
Cancer	77	0	77 (100%)
Diabetes	77	1 (1.3%)	76 (98.7%)
Thyroid or parathyroid gland disorders	77	1 (1.3%)	76 (98.7%)
Rheumatoid arthritis	77	11(14.3%)	66(85.7%)
Drug therapy			
Antidiabetic	77	0	77(100%)
Antacids	77	2(2.6%)	75(97.4%)
Immunosuppressant's	77	2(2.6%)	75(97.4%)
Glucocorticoids	77	7(9.1%)	70(90.9%)
Vitamin D	77	5(6.5%)	72(93.5%)
Calcium	77	3(3.9%)	74(96.1%)

Objective examination revealed an elevated BMI of 26.0 exceeding the norm by 4.2%. All men had DXA and blood tests for markers of bone metabolism. 28.6% of the men

had decreased BMD, from -1.5 SD and below. Calcium and alkaline phosphorus levels were normal, whereas, vitamin D deficiency was 16.2 ng/mL (Table 2).

Table 2.

BMI, blood and X-ray densitometry values.

Parameter	Indicator	Standard	
Age, average (years)	43.5±15.1		
Weight, kg	72	95% CI; 69.39-87.4	
Height, sm	170	95% CI; 167-174.5	
BMI, kg/m ²	26.0	95% CI; 24.0-29.6	
Densitometry (n=76)			
BMD normal	54 (70.1%)	T-scores and Z-scores	≥ -1.4 SD
BMD Low (osteopenia)	13 (16.9%)	T-scores and Z-scores	from -1.5 SD to -2.4 SD
BMD Lack (osteoporosis)	9 (11.7%)	T-scores and Z-scores	≤ -2.5SD
Biochemical blood test			
	n	Blood counts	Standard blood counts
Calcium	77	2.41(2.36-2.49) mol/L	2.25-2.75 mol/L
Vitamin D	77	16.2(13.5-18.8)ng/ml	30-100 ng/ml
Alkaline phosphatase	77	95.0(88.9-136.3) u/l	40-130 u/l

Table 3 presents the respondents' feedback to the questions on nutrition. As presented in the table, men rarely or do not consume seafood and fish (92.2%), nuts and dried fruits (80.5%), vegetables and greens (79.2%).

Table 3.

Dietary factors.

Parameter/ frequency of use	All Respondents (n= 77)
Consumption of milk and dairy products	
none or rarely	45 (58.4%)
often	32 (41.6%)
Vegetables and greens	
none or rarely	61 (79.2%)
often	16 (20.8%)
Meat products (red meat)	
none or rarely	10 (13.0%)
often	67 (87.0%)
Fish and seafood	
none or rarely	71(92.2%)
often	6 (7.8%)
Nuts and dried fruits	
none or rarely	62 (80.5%)
often	15 (19.5%)
Eggs	
none or rarely	55 (71.4%)
often	22 (28.6%)
Soda	
none or rarely	60 (77.9%)
often	17 (22.1%)
Fast food	
none or rarely	69 (89.6%)
often	8 (10.4%)

Discussion

Many factors contribute to the lower prevalence of osteoporosis and fractures in men compared to women [7]. Men tend to have larger bones than women (large bones are stronger than small bones) [11]. BMD determined by DXA method is the same in boys and girls before puberty and increases slowly. During puberty, bone metabolism increases dramatically (bone formation exceeds bone resorption), resulting in higher DXA values in boys. Furthermore, the increase in testosterone levels with the onset of puberty in males leads to an increase in the cross-sectional diameter of long bones. In males, maximum BMD of the spine by DXA is usually reached by age 18 years; in the hip, maximum BMD is reached several years later [1]. Therefore, men's BMD is 5-10% higher than women's BMD. However, this is not the reason why men have bone fractures less. In fact, bone strength is adequate for weight and height. With age, bone resorption is greater than bone formation, resulting in an age-related loss of bone mass of approximately 0.5-1.0% per year starting at age 30-40 years in men. However, men have a lower prevalence of low BMD than women of the same age at menopause. It is vital to note that fractures in men occur about 10 years later than in women, and therefore, due to advanced age, men may have more comorbidities and mortality from secondary

osteoporosis is higher in men [12]. It is known that the amount of bone removed during bone resorption in BMU (bone multicellular units) is equal to the amount of bone formed, so there is a "remodeling balance". In the skeleton of an older person (after age 50), the amount of bone removed no longer equals the amount of bone formed, and therefore there is a "negative remodeling imbalance" [9]. This decrease in bone mass is a key mechanism of age-related bone loss. In our study, out of 76 men, 54 had normal BMD, 13 had reduced BMD and 9 had osteoporosis. In our study the mortality due to osteoporosis was not studied, the sample was formed from 18 years of age, and the mean age of the men was 43.5 years. However, one third of the examined men had reduced BMD values.

A number of markers of bone metabolism associated with decreased bone mineral density are supplied through nutrition. Low calcium intake can lead to increased bone matrix resorption with demineralization and, consequently, increased fracture risk. International societies recommend a daily calcium intake of 1200-2000 mg per day [8]. In our study, questionnaire survey of men revealed that dairy products are rarely consumed by 58.4% and frequently consumed by 41.6% of the respondents and calcium is consumed by only 3%. Vitamin D is known to be a prosteroid hormone that plays an important role in calcium and phosphate metabolism. By stimulating the absorption of these elements in the intestine, vitamin D contributes to the maintenance of adequate serum calcium levels and hence bone mineralization. It can be obtained exogenously with nutrition, for example from wild marine fish such as salmon, but it is mainly produced endogenously by solar ultraviolet radiation in the skin [2]. Out of the 77 respondents, fish and seafood is rarely eaten by 92.2% of the men and only 7.8% of the men eat it frequently. The exogenous medication intake of vitamin D in the study group was 6.5%. However, it cannot be said about preventive or therapeutic intake of calcium and vitamin D, in view of the screening survey.

The enzyme alkaline phosphatase plays a major role in the process of bone formation. Osteoblasts secrete bone alkaline phosphatase contributing to mineralization and are also measured as biochemical markers of bone formation. As demonstrated in Table 3 the level of these markers in blood in our study was normal and was 2.41 mmol/L and 95.0 U/L for calcium and alkaline phosphatase respectively. However, the level of vitamin D – 16.2 ng/ml was insufficient.

In the world today, full-time employees tend to neglect their health. As a result, there is a growing number of lifestyle disorders such as hypodynamia, avitaminosis, due to insufficient lack of sunlight – hypovitaminosis D. These deficiencies can lead to various short and long-term complications and including decreased bone mineralization. When asked about physical activity, 74.0% of respondents replied that they move enough (Table 1). Nutrition rich in calcium, vitamin D, protein, n-3 Polyunsaturated Fatty Acids and physical activity at young ages may be important determinants of peak bone mass at young and older ages. [4].

Limitations of the study. One of the limitations of our study is the small sample and wide age range (young and adult). This is connected with the fact that men are reluctant to participate in screenings and surveys. The six-month

period for collecting information is also insufficient to generate a sufficient sample of respondents.

Conclusion. Based on the data of scientific studies on risk factors for osteoporosis in women, we can be noted that the same factors are applicable to the study osteoporosis in men. The results of our study allow us to make recommendations for the adult population of Abay region regarding adequate nutrition, including the consumption of food rich in calcium, protein and vitamin D, regular physical exercise, outdoor walks and smoking cessation.

Conflict of interest: The authors declare that there is no conflict of interest, and that no part of this article has been published in the open press and is not under consideration by other publishers.

Contribution of the authors: Conceptualization, *Madiyeva Madina*; methodology - *Mukanova Aray* and *Kultumanova Nurgul*; validation - *Ilyasheva Gulim*, *Almisaev Kairat*; investigation - *Raissov Daniyar*, *Tlegenov Azamat*, *Yerlanov Azamat* and *Yestayeva Zhanel*; resources - *Zhakupova Asemgul*, *Zamanbek Altnay* and *Lenskiy Yevgeniy*; data curation - *Ilyasheva Gulim* and *Yestayeva Zhanel*; writing-original draft preparation - *Madiyeva Madina* and *Ilyasheva Gulim*; writing-review and editing - *Madiyeva Madina*; project administration - *Madiyeva Madina*. All authors have read and agreed to the published version of the manuscript.

Funding: This research has been funded by the Science Committee of the Ministry of Science and Higher education of the Republic of Kazakhstan (Grant No. AP19680262 «Clinical and epidemiological characteristics of risk factors for the prevalence of osteoporosis in different age periods with assessment of the quantitative composition of bone tissue using dual-energy X-ray absorptiometry»)

References:

1. Gennari L., Bilezikian J.P. New and developing pharmacotherapy for osteoporosis in men. *Expert Opin. Pharmacother.* 2018, 19, 253–264. <https://doi.org/10.1080/14656566.2018.1428559>
2. Holick M.F., Chen T.C., Lu Z., Sauter E. Vitamin D and skin physiology: a D-lightful story. *J Bone Miner Res.* 2007 Dec. 22 Suppl 2:V28-33. doi: 10.1359/jbmr.07s211.
3. International Society for Clinical Densitometry. Available online: <https://iscd.org/learn/official-positions/> (accessed on 15 April 2024).

Информация об авторах:

- Mukanova Aray** - Assistant of the Department of radiology of NCJSC "SMU" mukanova.arai@mail.ru; 87773678898
- Raissov Daniyar** - ass. Professor of the Department of radiology of NCJSC "SMU" draisov@mail.ru; 87773668475
- Almisaev Kairat** - Master of Medicine of the Department of radiology of NCJSC "SMU" kayrat.almisayev@smu.edu.kz; 87478319010
- Kultumanova Nurgul** - Assistant of the Department of radiology of NCJSC "SMU" nurgul.kultumanova@smu.edu.kz; 87074172536
- Ilyasheva Gulim** - Resident radiologist - 2 years of training of NCJSC "SMU" gulim.ilyasheva.97@mail.ru; 87077497275
- Lenskiy Yevgeniy** - Resident radiologist – 1st years of training of NCJSC "SMU" zhenya.katon16@gmail.com; 87476149886
- Tlegenov Azamat** - Resident radiologist - 2 years of training of NCJSC "SMU" azamat-tlegenov@inbox.ru; 87771315500
- Yerlanov Azamat** - Resident radiologist – 1st years of training of NCJSC "SMU" Azamat.erlanov99@mail.ru; 87783149698
- Yestayeva Zhanel** - Resident radiologist - 2 years of training of NCJSC "SMU" nali_2005@mail.ru; 87772821481
- Zhakupova Asemgul** - Resident radiologist - 2 years of training of NCJSC "SMU" Semamed93@mail.ru; 87764921919
- Zamanbek Altnay** – Family doctor of the city Polyclinic No. 36, Almaty, Republic of Kazakhstan.

Corresponding Author:

Madiyeva Madina – PhD, MD, ass. Professor, Head of the Department of Radiology, NCJSC «Semey Medical University», Semey, Republic of Kazakhstan.

Mailing Address: 071412, Republic of Kazakhstan, Semey, Karmenova st. 61-3.

E-mail: m.madiyeva@mail.ru; madina.madiyeva@smu.edu.kz

Phone: 8 708 524 47 45

4. Kelsey J.L. Risk factors for osteoporosis and associated fractures. *Public Health Rep.* 1989. 104. Suppl:14-20.

5. Michelsen J., Wallaschofski H., Friedrich N., Spielhagen C., Rettig R., Ittermann T., Hannemann A. Reference intervals for serum concentrations of three bone turnover markers for men and women. *Bone.* 2013, 57(2), 399–404. doi:10.1016/j.bone.2013.09.010

6. Reginster J.-Y., Burlet N. Osteoporosis: A still increasing prevalence. *Bone.* 2006, 38(2), 4–9. doi:10.1016/j.bone.2005.11.024

7. Riggs B.L., Melton L.J., Robb R.A., Camp J.J., Atkinson E.J., McDaniel L., Amin S., Rouleau P.A., Khosla S. A population-based assessment of rates of bone loss at multiple skeletal sites: evidence for substantial trabecular bone loss in young adult women and men. *J Bone Miner Res.* 2008 Feb. 23(2):205-14. doi: 10.1359/jbmr.071020

8. Ross A.C., Taylor C.L., Yaktine A.L., Del Valle H.B., editors. Institute of Medicine (US) Committee to Review Dietary Reference Intakes for Vitamin D and Calcium. *Dietary Reference Intakes for Calcium and Vitamin D.* Washington (DC): National Academies Press (US). 2011. 125 p.

9. Schini M., Vilaca T., Gossiel F., Salam S., Eastell R. Bone Turnover Markers: Basic Biology to Clinical Applications. *Endocr Rev.* 2023 May 8. 44(3):417-473. doi: 10.1210/edrv/bnac031

10. Vilaca T., Eastell R., Schini. Osteoporosis in men. *The Lancet Diabetes Endocrinology.* 2022. 10(4). 273-283. doi.org/10.1016/S2213-8587(22)00012-2.

11. Wang X.F., Duan Y., Beck T.J., Seeman E. Varying contributions of growth and ageing to racial and sex differences in femoral neck structure and strength in old age. *Bone.* 2005 Jun. 36(6):978-86. doi: 10.1016/j.bone.2004.11.015. Erratum in: *Bone.* 2005 Oct. 37(4):599

12. Watts N.B. Osteoporosis in men. *Endocr Pract.* 2013. 19(5):834-8. doi: 10.4158/EP13114.RA.

13. World Health Organization. *Assessment of Fracture Risk and Its Application to Screening for Postmenopausal Osteoporosis.* Geneva: WHO; 1994. (WHO Technical Report Series, No. 843)