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Raková J.[1], Dankóová J.[2], Dimunová L.[1], Tomková S.[2], Červený M.[3]

Analysis of selected risk factors of osteoporosis

[1]Pavol Jozef Šafárik University in Košice, Faculty of Medicine, Department of the Nursing Care, Košice, Slovakia
[2]Osteocentrum, Hospital Košice-Šaca, a.s. Lúčna 57, Košice, Slovakia
[3]University of South Bohemia in České Budějovice, Faculty of Health and Social Sciences, Department of Nursing and Midwifery, České Budějovice, Czech Republic

jana.rakova@upjs.sk, jozefina.dankoova@nemocnicasaca.sk, lucia.dimunova@upjs.sk, sona.tomkova@nemocnicasaca.sk, m.cerveny.m@gmail.com

Ракова Я., Данкоова Й., Димунова Л., Томкова С., Червени М.
Аналіз окремих факторів ризику виникнення остеопорозу

Ракова Я., Данкоова Й., Димунова Л., Томкова С., Червени М.
Анализ отдельных факторов риска возникновения остеопороза

Introduction

Osteoporosis represents a progressive systemic disease characterised by loss of bone mass. Its clinical significance lies in adverse manifestations, especially in bone fractures. Annual number of fractures caused by osteoporosis in women is higher than the incidence of breast cancer or stroke [1]. It is estimated that by 2025 the number of people suffering from osteoporosis will have risen from current 27,5 million to 33,9 million people in the age range of 55 and above, which signifies a 23% increase [2]. The prevalence of the osteoporosis risk is particularly high in the European Union, where, in various countries, the rate of its occurrence within the entire population of 55-year-olds and older ranges from 15% to 21%. In Slovakia, 15,9% of inhabitants over the age of 55 suffer from osteoporosis, and, annually, 18 thousand fractures occur due to osteoporosis. The costs expended on its treatment represent 119 million EUR annually [3]. The estimated lifelong risk of an osteoporotic fracture is 40%, which is akin to that of cardiovascular diseases [4].

Osteoporosis is multifactorial. A significant factor in its development is genetic predisposition, race, and age [5]. A relevant element in its growth are modifiable lifestyle risk factors, i.e. dietary habits, physical activity, smoking, alcohol consumption. Sedentary lifestyle and insufficient physical activity also have a negative effect [6,7].

Our main aim was to identify the prevalence of risk factors related to the development of osteoporosis.

Methodology

The sample group consisted of 151 patients registered in Ostreocentrum. The selection criterion was age exceeding 50 and patient's consent with the collection and processing of data. Overall, the monitored group was comprised of 117 (77,5%) women and 34 (22,5%) men. The average age of the examined patients amounted to 64,2±8,9.

For the purpose of data collection, we selected standard methods used to identify osteoporosis:

1. We used the Hologic Discovery A system to perform densitometric examination. Bone density was evaluated in the lumbar spine and hip joint area. We determined the values according to the T-score (norm up to -1 SD; osteopenia -1 to -2.5 SD; osteoporosis <-2.5 SD) [4].

2. To assess fracture risk, we employed the WHO medical device, to assess the risk of an osteoporotic fracture – FRAX (Fracture Risk Assessment Tool) [8] which is available on the following website: https://www.sheffield.ac.uk/FRAX. The output of the aforementioned tool is a percentage denoting 10-year probability of a major osteoporotic fracture (i.e. spinal, forearm, and shoulder fractures) and femoral neck fractures. In Slovakia, this tool was officially accepted in January 2012 and it is suitable for men and postmenopausal women ranging from 40 to 90 years of age [9]. The following parameters are taken into consideration during assessment: age, sex, weight, height, history of previous fracture, parental history of hip fracture, smoking, long-term use of glucocorticoids, presence of rheumatoid arthritis, secondary osteoporosis, and alcohol consumption. For evaluation purposes, patients with FRAX≥20% for any osteoporotic fracture or ≥3% for a femoral neck fracture are considered high-risk [9].

3. The next part consisted of a questionnaire focused on demographic data, family history, associated diseases, and lifestyle risk factors – regimen.

Data collection was realised in Slovakia in Osteocentrum Nemocnica Košice-Šaca, a.s., Slovakia, in the period from December 2018 to April 2019. For the assessment of the obtained data, we used statistical software SPSS IBM 18.00, methods of descriptive and inductive statistics (Mann-Whitney test, Pearson correlation coefficient, ANOVA).

Results

The values of densitometric examination in the monitored group were as follows:

Spinal bone density assessment: within the norm n = 61 (40,4%); osteopenia n = 73 (48,3%); osteoporosis n = 17 (11,3%).

Bone density of the hip joint: within the norm n = 64 (42,4%); osteopenia n = 69 (45,7%); osteoporosis n = 18 (11,9%).

The calculation of the FRAX fracture risk profile yielded the following results:

FRAX – major osteoporotic fracture (i.e. spinal, forearm, and shoulder fractures) was evaluated as high-risk in 14 (9,3%) patients.

FRAX – femoral neck fracture was evaluated as high-risk in 41 (27,2%) patients.

Due to regimen being one of the monitored factors, we present a descriptive specification of selected items in Table 1. We can state that 50% of the monitored patients consume dairy products regularly, on a daily basis. Fish consumption can be considered insufficient (63,6%) along with the intake of ballast substances (nuts, almonds, etc.) in (52,3%) of the patients.

Table 1. **Food consumption monitored in patients (n = 151)**

	Consumption frequency, n (%)				
	daily	**3× a week**	**1× a week**	**sporadically**	**never**
Dairy products	76 (50,3)	36 (23,8)	5 (3,3)	27 (17,4)	7 (4,6)
Fish	3 (2,0)	12 (7,9)	34 (22,5)	**96 (63,6)**	6 (4,0)
Calcium preparations	52 (34,4)	3 (2,0)	2 (1,3)	22 (14,6)	72 (47,7)
Vitamin D preparations	56 (37,1)	3 (2,0)	6 (4,0)	17 (11,3)	69 (45,7)
Ballast substances	13 (8,6)	15 (9,9)	17 (11,3)	**79 (52,3)**	27 (17,9)
High-sodium foods	2 (1,3)	6 (4,0)	3 (2,0)	85 (56,3)	55 (36,4)

Analysis of the interdependence between the development of osteoporosis and selected risk factors

From the set of demographic indicators, we focused on sex and age. We researched whether there is a statistical significance between the indicators of osteoporosis (densitometric examination values, FRAX – osteoporotic fracture, FRAX – femoral neck fracture) and patient's biological sex. The assessment was conducted using the Mann-Whitney test. The incidence of osteoporosis in women was substantially higher than in men (p = 0,032). The incidence of the risk profile of FRAX – osteoporotic fracture was also statistically significantly higher in women than in men (p = 0,035).

Correlation with age was confirmed in these indicators: bone density of the hip joint, the risk profile of FRAX – osteoporotic fracture, and the risk profile of FRAX – femoral neck fracture. Correlation with age remained unconfirmed only in relation to bone density of the spine (r = 0,046; p = 0,574) (Tab. 2). Based on the information stated above, we can conclude that the risk of a fracture increases with age.

The incidence of risk factors within the scope of patient's **regimen** statistically significantly correlates with all four indicators, i.e. excessive values acquired through densitometric examination and also the determined risk profile of FRAX – osteoporotic fracture and FRAX – femoral neck fracture (Table 2).

Positive medical history as a risk factor was confirmed to be statistically significant in relation to the risk profile of FRAX – osteoporotic fracture (r = 0,263; p = 0,001) and FRAX – femoral neck fracture (r = 0,263; p = 0,001).

We were interested to find out whether the **presence of associated diseases** has an impact on osteoporosis. The assessment showed a negative correlation, which indicates that the osteoporosis and risk profile indicators present in our sample group are not affected by the number of associated diagnoses. Subsequently, we also conducted testing using the statistical method ANOVA, which allowed us to measure the values of the bone density of the spine (F = 0,053); of the bone density of the hip joint (F = 0,030); of the risk profile of FRAX – osteoporotic fracture (F = 0,296) and FRAX – femoral neck fracture (F = 0,623). This testing confirmed the conclusions deduced from the correlation analysis concerning the absence of an interdependence of the values regarding osteoporosis indicators and the number of associated diagnoses present in our sample group. All results can be found in Table 2.

Table 2. **Risk factors for the development of osteoporosis (n = 151)**

Risk factors	Bone density of the spine	Bone density of the hip joint	FRAX – osteoporotic fracture	FRAX – femoral neck fracture
age r	0,046	0,223**	0,284*	0,285***
p	0,574	0,006	0,012	0,001
regimen r	0,235**	0,272***	0,168*	0,228**
p	0,004	0,001	0,040	0,005
family history r	0,080	0,129	0,263***	0,263***

p	0,930	0,116	0,001	0,001
associated diagnoses r	-0,153	-0,212	-0,014	-0,034
p	0,060	0,009	0,864	0,678

r – Pearson correlation coefficient; p – statistical significance value: *p<0,05; **p<0,01; ***p<0,001.

Discussion

Nowadays, osteoporosis has almost become epidemic in nature, which can be linked to the ageing of the population, but especially to lifestyle. We focused on the analysis of selected risk factors related to its incidence.

From the set of demographic factors, we monitored age and sex. Our hypothesis concerning the increase of the fracture risk in relation to age was confirmed in the following indicators: bone density of the hip joint, the risk profile of FRAX – osteoporotic fracture and FRAX – femoral neck fracture. In their research, Némethová et al. [10] determined that the ratio of high-risk patients increased along with their age. They also pointed out the possibility of identifying increased fracture risk using the FRAX tool.

European Prospective Osteoporosis Study (EPOS) shows that women face more than doubled vertebral body compression fracture risk in comparison to men [11]. Women of reproductive age are positively affected by oestrogens, which protect them from the loss of bone mass. However, after menopause, the loss of bone mass is substantially accelerated [12]. The influence of testosterone is taken into consideration in relation to men; testosterone levels start to decline between the ages of 60 and 65; this decline is a slower process than that of oestrogen in women [5]. In comparison to women, men sustain an osteoporotic fracture roughly 10 years later [13]. A large-scale Canada-based population study also confirms a high risk of osteoporosis development in 12% of women and 6% of men [14]. The incidence in women also prevailed in the sample group monitored for the purposes of our research.

Health-promoting behaviour such as a healthy diet could have an impact on a chronic disease like osteoporosis [15]. From the set of modifiable lifestyle risk factors, we focused on regimen, particularly on the consumption of dairy products, fish, calcium and vitamin D preparations, ballast substances, and high-sodium foods [16]. We hypothesised that bone density of the spine, the hip joint, and the 10-year fracture probability would correlate with the above-stated regiment factors; this presupposition was proved correct in our monitored group of patients. Similarly, in their empirical investigation Gabrhelová, Miklovičová [17] observed considerable reservations concerning the motivation of patients to comply with the necessary regiment alterations regarding regular calcium consumption – the recommended daily intake of dairy products as a source of calcium was given only by 18% of respondents. Authors Zamboriová [17] and Levis, Lagari [19] state that proteins, calcium, vitamin D, fruit, and vegetables have a positive effect on bone health, whereas a high-calorie diet and excessive alcohol consumption are connected to lower bone density and higher fracture rate. Positive effects of vitamin D in relation to osteoporosis is discussed by Szamosi, et al. [20]. Significant findings regarding low vitamin D levels were recorded in the research conducted by Bačová et al. [21] which states that vitamin D deficit in women between the ages of 50 and 80 was present in staggering 87% of cases and in 80,1% of men within the same age range. This suggests that hypovitaminosis in women and men in the aforementioned age group can also have an impact on the development of osteoporosis. The benefits of calcium in relation to bone density is discussed by Watts et al. [22] and Kendler at al. [23].

A parental history of a femoral neck fracture is also a significant factor independent of bone density and genetically conditions increased risk of any kind of fracture, including a proximal (upper extremity) femur fracture [17]. Within our monitored group, positive family history was confirmed as significant only in regard to the assessment of FRAX – osteoporotic fracture and FRAX – femoral neck fracture. Previously sustained fracture associated with osteoporosis is a particularly important independent factor which doubles the risk of a subsequent fracture.

We also had an interest in patients' associated diseases in connection to the incidence of osteoporosis. We examined associations among the following diseases: celiac disease, Crohn's disease, hyperthyroidism, diseases of the liver, diabetes mellitus, chronic kidney disease, primary hyperparathyroidism, rheumatoid arthritis, and oncological diseases. During the assessment of patients' medical history, we determined that from the above-stated diseases, patients suffered from diabetes mellitus (23%) followed by rheumatic diseases (14,6%) and oncological diseases (7,6%). The American Gastroenterological Association (AGA) states that several gastrointestinal diseases are accompanied by varying degrees of osteoporosis. It is estimated that more than 30% of cases of osteopenia or osteoporosis are found in patients suffering from inflammatory bowel disease [24]. It has also been proven that patients with diabetes mellitus are exposed to increased risk of low-trauma fractures including femoral neck fractures [25]. On these grounds, we hypothesised that the incidence of osteoporosis in the spinal area, the hip joint region, and the risk profiles of FRAX – osteoporotic fracture and FRAX – femoral neck fracture would statistically significantly increase along with the incidence of risk factors when there is a rise in the number of associated diagnoses present. Based on the negative correlation, it can be stated that the incidence of osteoporosis and the fracture probability according to the FRAX tool within our monitored group were not affected by the presence of associated diseases.

Conclusions

Osteoporosis is a chronic non-infectious disease with a rapidly growing medical, socio-economic, and societal status. Within our monitored group, we successfully confirmed that the risk of osteoporosis development increases along with age. Higher prevalence was recorded in women rather than men. We can state that positive family history and regimen risk factors do affect the development of osteoporosis. Within our

monitored group, associated diseases do not appear to hold statistical significance in relation to the development of osteoporosis. In the period from 2015 to 2030, the estimated increase of world population aged 60 and above will mark a 56% increase, and by the year 2050, the world's population of elderly people will have doubled.

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Aim: presently, osteoporosis represents a chronic, non-infectious disease with an expanding health-related, socioeconomic, and society-wide dimension. The aim is to identify the risk of a bone fracture, and to map out the risk factors related to the development of osteoporosis.

Materials and methods. The sample consisted of 151 patients with the average age of 64.2 (SD±8.9) registered in Ostreocentrum. To identify the risk of an osteoporotic fracture, we have utilized the FRAX (Fracture Risk Assessment Tool) method and densitometric screening. In relation to osteoporosis, we monitored the risk factors such as age, gender, family history, associated diseases, and nutrition.

Results. The results of our monitored group confirmed the fact that the risk of osteoporosis development does rise along with age. Higher prevalence occurred in women than in men. We can state that positive family history and the nutrition do influence development of osteoporosis. Associated diseases did not appear to be statistically significant in relation to the development of osteoporosis.

Conclusions. The results show that both primary and secondary prevention of osteoporosis need to be strengthened.

Key words: osteoporosis, risk factors, non-infectious disease, densitometric, secondary prevention.

Мета. В даний час остеопороз є хронічним неінфекційним захворюванням, що має все більш широкий, пов'язаний зі здоров'ям, соціально-економічний та суспільний вимір. Мета дослідження полягає в тому, щоб визначити ризик виникнення перелому кісток і скласти карту факторів ризику, пов'язаних з розвитком остеопорозу.

Матеріали та методи. Було обстежено 151 хворих середнього віку 64,2 року (SD±8,9), які були зареєстровані в Остеоцентре. Щоб визначити ризик виникнення остеопоротичних переломів, ми використовували метод FRAX (Fracture Risk Assessment Tool) і денситометричний скринінг. Що стосується остеопорозу, ми відстежували такі фактори ризику: вік, стать, сімейний анамнез, супутні захворювання і харчування.

Результати. Результати нашого спостереження групи дослідження підтвердили той факт, що ризик розвитку остеопорозу росте з віком. Більш висока частота остеопорозу зустрічалася у жінок, ніж у чоловіків. Можна констатувати, що позитивний сімейний анамнез і харчування дійсно впливають на розвиток остеопорозу. Супутні захворювання не виявлено статистично значущими щодо розвитку остеопорозу.

Висновки. Результати показують, що необхідно посилити як первинну, так і вторинну профілактику остеопорозу.

Ключові слова: остеопороз, фактори ризику, неінфекційні захворювання, денситометрія, вторинна профілактика.

Ethical aspects and conflict of interest: authors solemnly declare that all procedures and proceedings related to the collection of patients' data were conducted in accordance with the 1975 Helsinki Declaration and its most recent amendment dated October 2013.

The authors declare and confirm that there are no known conflicts of interest associated with this publication.

Відомості про авторів

Raková Jana – PhDr, PhD, Pavol Jozef Šafárik University in Košice, Faculty of Medicine, Department of The Nursing Care, Tr. SNP 1, Košice, Slovakia.
jana.rakova@upjs.sk.

Dankóová Jozefína – Mgr, Osteocentrum, nemocnica Košice-Šaca, a.s. Lúčna 57, Košice, Slovakia.
jozefina.dankoova@nemocnicasaca.sk.

Dimunová Lucia – doc., PhDr, PhD, Pavol Jozef Šafárik University in Košice, Faculty of Medicine, Department of The Nursing Care, Tr. SNP 1, Košice, Slovakia.
+421 (55) 234-32-92, lucia.dimunova@upjs.sk.

Tomková Soňa – MUDr, PhD, MPH, Osteocentrum, nemocnica Košice-Šaca, a.s. Lúčna 57, Košice, Slovakia.
sona.tomkova@nemocnicasaca.sk.

Červený Martin – PhDr, PhD student, University of South Bohemia in České Budějovice, Faculty of Health and Social Sciences, Department of Nursing and Midwifery, České Budějovice, Czech Republic.
m.cerveny.m@gmail.com.