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OSTEOPOROSIS RISK FACTORS IN THE FEMALE POPULATION IN URBAN AND RURAL ENVIRONMENTS

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Abstract

Osteoporosis is a progressive, systemic, chronic, metabolic bone disease that leads to loss of bone mass, damage to the microarchitecture of bone tissue, and increased bone fragility. Osteoporosis affects 10% of the world's population and it mainly occurs in people over 50 years old (more often in women). It is a disease that significantly affects the quality of life and can lead to disability, and fractures as the main complication are the cause of increased mortality in these patients. The number of people suffering from this disease is increasing, and considering that it develops without symptoms, osteoporosis has received the epithet "silent epidemic". The aim of the research was to compare the risk factors for the occurrence of osteoporosis in an urban region compared to a rural region.

The retrospective study involved 40 female respondents, over 45 years old, from the urban region of Sanski Most municipality and 40 female respondents, over 45 years old, from the rural region of Doboj municipality. For the purposes of the research, a quick test for osteoporosis was used in the form of a nine-question questionnaire. The statistical significance of the difference in the answers obtained during the osteoporosis test, in different cities, was evaluated by the χ^2 test.

The χ^2 test showed that there is a statistically significant difference in the answers to the question "do you smoke more than 20 cigarettes a day". 16 respondents, from the urban area of the municipality of Sanski Most, answered that they smoke more than 20 cigarettes a day, while only 5 respondents, from the rural area of the municipality of Doboj, answered in the affirmative. Smoking is one of the risk factors for osteoporosis. For the other questions, no statistically significant difference was found in the responses of respondents living in urban and rural regions.

Based on the obtained results, it can be concluded that there is no statistically significant difference in the influence of individual risk factors on the occurrence of osteoporosis in women living in urban and rural regions.

***Key words**: Osteoporosis, Risk factors, Female gender.*

1. Introduction

Osteoporosis is a chronic degenerative bone disease that seriously affects people's health. It is characterized by destruction of bone microstructure, reduction of bone mass and increased bone fragility, which leads to an increased risk of secondary fracture. The World Health Organization defines osteoporosis as a decrease in bone mass density (BMD) by more than 2.5 standard deviations compared to a healthy population aged 20 - 29. Although it is difficult to estimate osteoporosis rates, it is believed that 25 million women and 12 million men worldwide suffer from osteoporosis [1]. Whites and asians are more likely to suffer from osteoporosis than blacks and hispanics [1] .

In the Federation of Bosnia and Herzegovina, an average of 4,207 cases of osteoporosis were registered annually, and during the five-year monitoring period (2015 - 2020), a morbidity rate of 193/100,000 per year was recorded. In 2020 alone, 3,922 diagnoses were recorded, with an incidence ratio of 2.3 women per 1 man. In the same year, women experienced a 6 times higher incidence of osteoporosis between the ages of 50 and 59 than at an earlier age, and the largest number of patients belonged to the age group between 70 and 79. At the same time, men record an increase in the incidence at a slightly later age, at the age of 60 - 64 and reach the peak of the incidence between the ages of 65 and 69 [2].

A frequent complication of this disease is fractures. The most common are vertebral fractures and they are often difficult to diagnose. Hip fractures are the second and distal forearms the third most frequent osteoporotic

fractures. Only 5% of fractures occur spontaneously, while the rest are the consequences of a fall, although only 12% of falls in elderly people end in a fracture.

It is necessary to distinguish between primary (involutive) and secondary osteoporosis (caused by other diseases or taking drugs). Primary osteoporosis is divided into postmenopausal, that is, caused by a lack of estrogen, but also androgen (type 1) and osteoporosis associated with aging (senile osteoporosis - type 2). Primary osteoporosis is characterized by trabecular bone loss. Age-related osteoporosis (type 2) occurs in people of both sexes over the age of 70. In this type of osteoporosis, both trabecular and cortical bone are affected. Secondary osteoporosis can be associated with diseases such as hyperparathyroidism, diabetes, hyperthyroidism, immobility, chronic kidney disease, Cushing's disease and growth hormone deficiency in adults [3].

Loss of bone mineral density (BMD) is associated with hormonal imbalance, i.e. endocrine diseases, aging, environmental factors, lifestyle and heredity [4]. Complex interactions between genetic and environmental factors contribute to the pathophysiology of osteoporosis [5 - 7].

The group of factors that we cannot influence include: gender, age, race and genetics. A variable group of factors consists of: body weight, diet, consumption of alcohol, cigarettes and coffee, insufficient physical activity, medications and some other diseases [3]:
a) Gender: Women suffer from osteoporosis more often. After the age of 50, menopause occurs in women (it can occur even before the age of 45), when the level of estrogen in the blood decreases, which causes accelerated bone breakdown and loss of bone mass. Women lose about 40 - 50% of their bone mass in their lifetime. Men lose bone mass more slowly because their testosterone level declines more slowly, and they lose 20 - 30% of their bone mass during their lifetime [3].
b) Positive family history of fractures: Genetic factors have the greatest influence on reaching maximum bone density. According to some studies, up to 80% of the maximum bone density achieved depends on genetic factors [8]. Children of mothers with lower BMD have lower BMD values compared to the general population [9]. Studies show that gestational age and menarche correlate significantly when comparing three generations (grandmother, mother, and daughter), while BMD correlates between mother and granddaughter (first degree of consanguinity). No significance was observed between grandmother's and mother's BMD, as well as grandmother's and granddaughter's. In the same study, it was shown that the level of physical activity, intake of calcium and vitamin D correlate significantly in mothers and daughters, which can be explained by educational measures on adequate intake of calcium and vitamin D, as well as the level of physical activity in families [10].
c) Old age: In childhood and early youth, the building processes are stronger, then the bone builds up and reaches its maximum at the age of 30. From the age of 30 to the age of 50, the processes are in balance, and after that period the processes of decomposition dominate and the loss of bone mass begins [3].
d) Race: The frequency of osteoporosis is higher among the Caucasian population.
e) Body weight: Body mass index (BMI) is associated with increased bone strength and reduced risk of contractures. BMI and BMD are related, and as one increases, so does the other, however, recent research shows that the increase in BMD is not proportional to the increase in BMI, and with an increase in body mass, there is an increased risk of bone fractures [11]. Low body mass (BMI < 19 kg/m ^{2}) increases the risk of fractures, but when we talk about bone mass, the structure of the body itself plays a big role. The three-component model of body composition includes fat, bone mineral, and muscle mass. Adipose tissue and muscles are active components that affect bone through humoral and biomechanical mechanisms [12]. Muscles exert a mechanical force on the bone, which creates mechanical stress on the osteoblasts, causing their activation. On the other hand, fat tissue cells secrete adipokines in high concentrations and numerous hormones that inhibit the formation of new bone and thus cause a decrease in BMD [13].
f) Nutrition: A diet rich in fruits, vegetables, reduced-fat dairy products, whole grains, meat, fish, nuts and legumes has been found to have beneficial effects on bone strength, which is directly related to improved BMI and lower risk of fractures. Recent findings have shown that adherence to the Mediterranean diet protects against osteoporosis [14]. Lack of vitamin D poses a risk of accelerated bone loss, fractures and osteoporosis. This vitamin is introduced into the body through food in the form of vitamin D2, which is of plant origin, and vitamin D3, which is of animal origin. 80 to 90% of the required vitamin D is obtained through the endogenous synthesis of vitamin D3 in the skin through ultraviolet light. Foods rich in this vitamin are: blue fish, salmon, milk, yogurt, cod liver oil, fruit juices that increase calcium absorption by 30% [15].
g) Alcohol and smoking: Increased alcohol consumption increases the risk of osteoporosis and fractures. It is toxic to osteoblasts, and has a stimulating effect on osteoclasts. A moderate amount of alcohol can cause a decrease in bone density. Chuan Yuan *et al.*, [16], believe that men who consume alcohol have a higher risk of developing osteoporosis. Cigarette consumption is one of the habits that adversely affects bone health. By smoking, calcium

is absorbed from food in the intestines and has a negative effect on the bone building process. Women who consume tobacco products enter menopause a year or two earlier, and by consuming more than 20 cigarettes per day, bone mineral density decreases by 10% in menopause, compared to non-smokers. It also affects the production of estrogen and testosterone, and it has been proven that smokers are less physically active, which indicates another risk factor for osteoporosis.

h) Coffee: Due to its diuretic effect, caffeine leads to increased excretion of calcium and magnesium from the urine. It is important to limit intake to no more than four cups of coffee per day [15].

i) Physical activity: Physical inactivity and a decrease in the load on the bone system lead to a decrease in bone mineral density [17]. The post-menopausal period is associated with a low level of physical activity [18], and consequently there is reduced bone stimulation, decreased muscle strength, coordination and balance [19]. Participating in sports that are characterized by stronger collisions with the surface (joint load during running, jumping...), especially before puberty, is an important factor in increasing bone mass and reaching a higher peak bone mass, regardless of gender [20]. There is a lot of strong scientific evidence indicating that physical activity during childhood is associated with better maintenance of bone mass in later periods of life [21,22]. Research comparing bone density in athletes and non-athletes has generally indicated that athletes have a higher bone mass than non-athletes. It has also been shown that strength sports (eg weight lifting) have a beneficial effect on bone mass than aerobic sports or even swimming [23]. Gravitational load plays a decisive role.

j) Medicines: Opoids, antidepressants, sedatives, cytostatics, anticoagulants, antiepileptics and corticosteroids increasingly increase the risk of osteoporosis and fractures [24]. Medicines can increase the impact on body mass and strength, as in the case of corticosteroids, hypnotics and anxiolytics, which are associated with an increased risk of increased bone breakdown due to comorbidities. The elderly population, characterized by osteoporosis and osteoporotic fractures, often have chronic autoimmune and degenerative diseases, which require long-term treatment and frequent use of corticosteroid therapy. The mechanisms of osteoporosis can be explained by the metabolic changes of all the cells involved in osteogenesis and bone resorption, as well as the accompanying phenomena on the muscle tissue, which affects the entire locomotor system. It is basically a disorder at the level of osteoblasts, which represent the carrier of bone formation. As a result of the action of corticosteroid therapy, their metabolic and functional activity, and thus differentiation and proliferation, are reduced.

Many environmental factors and lifestyle habits that are known to have an impact on bone density are different in urban and rural populations. Thus, for example, menarche and menopause, which in the urban and rural population of women can occur at different ages, can have an impact on bone metabolism [25]. Other factors such as dietary habits, alcohol consumption, smoking and family history are differently represented in rural and urban populations and may have an impact on bone mass [25]. Rural and urban populations also differ in the occurrence of various diseases, including hip fractures, as published in papers from North America, Scandinavia and Asia. In most papers, it was shown that the incidence of hip fractures is lower in the rural population [25]. A Polish study of 900 women showed that differences in risk factors for osteoporosis between rural and urban populations, such as calcium intake, gynecological factors, smoking and coffee consumption, are significant [25] .

An Australian study by Sanders et al from 2002 also found significant differences in the incidence of hip fracture between rural and urban populations [26]. The hip fracture rate in the rural population was 15% lower. On the other hand, Swedish research published in 2010 that followed a population of urban and rural women from 1987–2002. did not confirm the difference in hip fracture incidence between the urban and rural population of women, as well as the difference in bone mass density [27].

In previous research on osteoporosis in Bosnia and Herzegovina, the importance of prevention, the prevalence of osteoporosis, and fractures were investigated, while there is no data on the most common risk factors in rural and urban areas. Therefore, it was decided that in this paper, the representation of the most common risk factors for the occurrence of osteoporosis in urban and rural areas of Bosnia and Herzegovina will be analyzed and whether there is a difference in the incidence of certain risk factors between urban and rural regions.

2. Materials and Methods

The research was designed as a retrospective study. It included 80 female respondents, over 45 years old. 40 respondents are from the urban area of the municipality of Sanski Most and 40 respondents are from the rural area of the municipality of Doboj. The survey method was used, which researches and collects data, information, attitudes and opinions on the subject of research on the basis of survey questionnaires. The conducted research was completely anonymous and voluntary. The questionnaire used was taken from the International Osteoporosis Foundation website [28]. The test contains 9 questions to which the respondents

answered yes or no. It was explained to all respondents in advance that the obtained results will be used exclusively for research purposes. It took ten minutes to fill out both questionnaires. The statistical significance of the difference in the answers obtained during the osteoporosis test, in different cities, was evaluated by the χ^2 test (at the $\alpha = 0.05$ significance level).

Data obtained from the questionnaire were following:
A1. Did any of your parents have osteoporosis and/or hip fracture after a fall and/or spontaneously?
A2. Did you have a fracture after a fall or minor impact?
A3. Have you been taking corticosteroids for more than three months (Pronisone, Dexamethasone,...)?
A4. Do you often drink three or more drinks?
A5. Do you have Crohn's disease, ulcerative colitis or celiac disease?
A6. Have your periods stopped for 12 months or longer but not due to menopause or pregnancy?
A7. Have you lost more than 3cm in height?
A8. Do you smoke more than 20 cigarettes a day?
A9. Did you lose your period before the age of 45

3. Results and Discussion

The results of the examination of risk factors related to the influence of genetics, the tendency to fractures and the reduction of body height are shown in Table 1. In the total sample, 11 female subjects from the area of the municipality of Doboj had a positive family history of osteoporosis, while 7 female subjects from the area of the municipality Sanski Most had a positive family history of osteoporosis. 9 female subjects from the area of the municipality of Doboj and 3 female subjects from the area of the municipality of Sanski Most had a fracture. In the total sample, 11 female subjects from the area of the municipality of Doboj and 11 female subjects from the area of the municipality of Doboj registered a decrease in body height of more than 3 cm. In the case of unchangeable risk factors for the occurrence of osteoporosis, it was concluded that the surveyed persons from the rural area of the municipality of Doboj do not differ statistically significantly from the persons from the urban area of the municipality of Sanski Most (Table 1).

The data from Table 2 refer to the use of corticosteroid therapy and the existence of certain chronic diseases, where no statistically significant difference was recorded (A3 $\chi^2 = 2.051$, $\alpha = 0.05$; A5 $\chi^2 = 1.012$, $\alpha = 0.05$).

Regarding the risk factors related to cigarette consumption, it was concluded that the respondents

Table 1. Risk factors related to the influence of genetics, tendency to fractures and reduction of body height

Question	Response frequency			Expected response frequency ***			χ^2 (N, df)
A1	NOT	YES	In total	NOT	YES	In total	
Get it	29	11	40	31	9	40	
Sanski Most	33	7	40	31	9	40	$\chi^2(1,84) = 1,146$
In total	62	18	80	62	18	80	
A2	NOT	YES	In total	NOT	YES	In total	
Get it	31	9	40	34	6	40	
Sanski Most	37	3	40	34	6	40	$\chi^2(1,84) = 3,529$
In total	68	12	80	68	12	80	
A7	NOT	YES	In total	NOT	YES	In total	
Get it	29	11	40	29	11	40	
Sanski Most	29	11	40	29	11	40	$\chi^2(1,84) = 0$
In total	58	22	40	58	22	80	

Legend: ***expected frequencies in each cell were obtained by multiplying the row sum by the column sum and dividing the result by the total sum of frequencies.

Table 2. Risk factors related to medication and chronic diseases

Question	Response frequency			Expected response frequency ***			χ^2 (N, df)
A3	NOT	YES	In total	NOT	YES	In total	
Get it	38	2	40	39	1	40	
Sanski Most	40	0	40	39	1	40	$\chi^2(1,84) = 2,051$
In total	78	2	80	78	2	80	
A5	NOT	YES	In total	NOT	YES	In total	
Get it	39	1	40	39.5	0.5	40	
Sanski Most	49	0	40	39.5	0.5	40	$\chi^2(1,84) = 1,012$
In total	79	1	80	79	1	80	

Legend: ***expected frequencies in each cell were obtained by multiplying the row sum by the column sum and dividing the result by the total sum of frequencies.

Table 3. Risk factors related to alcohol and cigarette consumption

Question	Response frequency			Expected response frequency ***			χ^2 (N, df)
A4	NOT	YES	In total	NOT	YES	In total	
Get it	38	2	40	38.5	1.5	40	
Sanski Most	39	1	40	38.5	1.5	40	$\chi^2(1,84) = 0,346$
In total	77	3	80	77	3	80	
A8	NOT	YES	In total	NOT	YES	In total	
Get it	35	5	40	29.5	10.5	40	
Sanski Most	24	16	40	29.5	10.5	40	$\chi^2(80,1) = 7,812779$
In total	59	21	80	59	21	80	

Legend: ***expected frequencies in each cell were obtained by multiplying the row sum by the column sum and dividing the result by the total sum of frequencies.

Table 4. Risk factors related to menstrual cycle disorder and early menopause

Question	Response frequency			Expected response frequency ***			χ^2 (N, df)
A6	NOT	YES	In total	NOT	YES	In total	
Get it	34	6	40	34.5	5.5	40	
Sanski Most	35	5	40	34,	5.5	40	$\chi^2(80,1) = 1,632$
In total	69	11	80	6	11	80	
A9	NOT	YES	In total	NOT	YES	In total	
Get it	33	7	40	33.5	6.5	40	
Sanski Most	34	6	40	33.5	6.5	40	$\chi^2(80,1) = 0,0918482$
In total	67	13	80	67	13	80	

Legend: ***expected frequencies in each cell were obtained by multiplying the row sum by the column sum and dividing the result by the total sum of frequencies.

from the area of Doboj municipality differ statistically significantly from the respondents from Sanski Most. 5 respondents from the Doboj municipality consume cigarettes, and 16 respondents from the Sanski Most municipality consume cigarettes (A8 χ^2 = 7.812779, α = 0.05). Regarding alcohol consumption, there is no statistically significant difference between Doboj and Sanski Most (A4 χ^2 = 0.346, α = 0.05) (Table 3).

The results related to menstrual cycle disorder and early menopause are shown in Table 4. There was also no statistically significant difference (A6 χ^2 = 1.632, α = 0.05; A9 χ^2 = 0.0918482, α = 0.05).

4. Conclusions

- The conducted survey showed that there is no statistically significant difference in the responses of respondents from rural and urban areas to 8 questions, while there is a statistically significant difference in the answers related to smoking as a risk factor for the onset of osteoporosis, according to the responses of the respondents (A8 χ^2 = 7.812779 , α = 0.05).
- Analyzing non-modifiable risk factors, a decrease in body height was observed in both groups.
- Other risk factors are not significantly expressed.

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