

Osteoporosis as a Problem of Postmenopausal Women

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Original Article

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Abstract:

Introduction: Osteoporosis is one of the major public health problems, and its prevalence is most often associated with menopause.

Aim: To analyze bone mass status in menopausal women with regard to age, BMI and duration of menopause.

Method: A retrospective analysis of the densitometric examination results of 650 postmenopausal women was used. We performed simple and multiple regression, while we considered the densitometry examination conclusion as the dependent variable. We calculated correlation coefficients (r), determination coefficients and their level of significance.

Results: The occurrence of osteoporosis is associated with age. In the age category under 50 years, bone tissue remodeling was detected in 46.92% of women, while in the over 50 category it was 32.92%. The dependence of the duration of

menopause in years and the onset of bone remodeling was also confirmed, $t_{Stat}=2.26$ ($t_{crit} = 1.647$). The negative correlation of the conditionality of the onset of menopause and weight ($r = -0.067$, very weak dependence) confirms the assumption that women with higher weight enter menopause at an older age. The negative value of the correlation ($r = -0.2218$ weak dependence) confirms that the degree of osteopenia or osteoporosis decreases with an increasing BMI value. The onset of osteopenia or osteoporosis is not conditioned by intolerance to dairy food $p = 0.6652 > \alpha = 0.05$ or smoking $p = 0.448 > 0.05$.

Conclusion: The obtained results show that the occurrence of osteopenia and osteoporosis is related to the age of women and the duration of postmenopause. The degree of osteopenia or osteoporosis decreases with increasing BMI. Bone tissue remodeling is not related to dairy food intolerance or smoking in the observed group. In connection with the occurrence of osteoporosis in postmenopausal women, it is necessary to raise public awareness of the importance of regular bone densitometry monitoring.

Introduction

Osteoporosis is one of the serious public health problems associated with considerable sickness and socio-economic burden (1). Its prevalence is most often associated with menopause (2). Menopause as a biological process typically occurs between the ages of 40 and 60, (average value 51 years). Natural menopause is defined as the cessation of the menstrual cycle for 12 consecutive months resulting from a lack of ovarian follicular activity (3). Early menopausal age is associated with an increased risk of cardiovascular disease and osteoporosis. Environmental factors explain only a small part of the variance in menopausal age. (4). Menopause is a critical time for bone health, with rapid bone loss occurring in the three-year period following the last menstrual cycle. Bone density measurements may be clinically useful in predicting the onset of a phase of rapid bone loss and in identifying women who are most at risk for osteoporosis during menopause. Monitoring bone density is also important in assessing the effectiveness of osteoporosis treatment (5).

According to Brown et al., (2009), osteoporosis is the most common cause of fractures. It is estimated that approximately 30% of postmenopausal women in the United States and the European Union suffer from osteoporosis. In Asia, the overall prevalence of postmenopausal osteoporosis is higher than in Western countries (2).

Payer et al., (2007), identified genetic predisposition, age and gender as non-influential factors in the development of osteoporosis. Factors that can be influenced include physical inactivity, calcium intake in food, smoking and excessive alcohol intake (6).

Opinions on the protective effect of excess weight against osteoporosis are not unequivocal (7). A higher body mass index (BMI) is a key problem that greatly affects people's health (8). A higher body mass index (BMI) as a protective factor reducing bone loss is reported by several authors (1,7,9). Guiming et al. (2019) reports higher BMI values as a risk factor for the development of postmenopausal bone remodeling (10).

The described starting points were the incitement for conducting research aimed at a detailed analysis, which provides a systematic overview of the factors supporting the development of osteoporosis in menopausal women. We mapped the area of key factors: duration of menopause, climacterium, woman's age, obesity, BMI, smoking.

Methodology

In the conducted research, a retrospective content analysis of health documentation in the form of an "evaluation study" was used. The results of the examination of women who underwent a densitometric examination at a specialized densitometric workplace in Banská

Bystrica (SK) were reviewed, more specifically from January to October 2020. The data on each examined woman were processed in the MS Excel program. A descriptive analysis of all variables was performed. Statistical analysis was performed using Pearson’s chi-square test and t-test. We calculated BMI using the formula weight (kg) / height (m²).

We investigated clinically significant factors that can lead to osteoporosis in a group of 650 women. In our observation, we included the age of the respondents, the age at the onset of menopause, ovariectomy, hysterectomy, diseases of the thyroid gland and kidneys, GIT, weight (BMI), dairy food intolerance and smoking.

Only women in postmenopause, natural or artificially induced climacteric after bilateral ovariectomy were included in the group. The age of the respondents, their education and social status did not determine their inclusion in the group. A 20-year-old female respondent was not included in our study because of the high age deviation.

According to the WHO, densitometry results are classified into four categories: A. Norm: T-score > - 1; B. Osteopenia: T-score >-1.r > T-score > - 2.5; C. Osteoporosis: T-score < - 2.5; D. Manifest osteoporosis: T-score < - 2.5 + at least one fracture.

Table 1 Distribution of the group according to age and onset of menopause

	min	max	average	s
Age	39	90	63,4769	8,3915
Onset of menopause	32	61	49,3384	4,6039

Table 2 Incidence of the disease by age categories, absolute and relative values

Category diseases	Age				Σ	
	< 51		>50			
	n	%	N	%	N	%
0	44	6,7692	87	13,3846	131	20,1538
1	140	21,5384	205	31,5384	345	53,0769
2	74	11,3846	100	15,3846	174	26,7692
Σ	258	39,6923	392	60,3076	650	100

Legenda: 0 norm; 1 osteopenia; 2 osteoporosis;

The number of fractures to determine manifest osteoporosis was not recorded in the medical records examined by us. For the analysis of the densitometry results, we therefore divided the respondents into three categories: 0=norm; 1=osteopenia; 2=osteoporosis.

The main aim of the study was to analyze the impact of hormonal remodeling due to menopause and the ongoing climacteric effect on the occurrence of osteoporosis in the context of the duration of postmenopause, age and BMI of the woman.

The sub-objectives of the study were to assess the influence of the respondents’ ages at the time of measurement, the ages at the onset of menopause, the number of years lived in menopause and body weight expressed in BMI values on the occurrence of osteopenia or osteoporosis in postmenopausal women.

Results

We monitored the onset of menopause and associated problems with hormonal changes in a sample of 650 women aged 39 to 90; the average age of the respondents was 63.5.

We excluded one female respondent 20-year-old from the study due to high age deviation. The basic numerical characteristics of the collection are listed in Table 1.

In the age category over 50 years old, postmenopausal bone tissue remodeling was recorded in a total of 46.92% of women, while in the age category under 50 years old, some form of bone tissue remodeling appeared in 32.92% of women. The most frequent diagnosis in both age categories was osteopenia. Only 20% of women in the monitored group did not suffer from any form of bone remodeling. We present the results in Table 2.

Table 3 Numerical characteristics of the weight sign, onset of menopause

	Weight in kg	Onset of menopause in years	Osteopenia, osteoporosis
r	73,8553	49,3384	1,0661
s	14,2243	4,6039	0,6818

The relationship between weight and the onset of menopause

We investigated the relationships between the occurrence of osteopenia/osteoporosis, the weight of the respondents and the age at the onset of menopause.

More than 90% of female respondents experienced menopause between the ages of 40 and 58.

The mutual conditionality of the onset of menopause and weight, expressed by the correlation coefficient r , has a value of $r = -0.0671$. This is a very weak dependence. However, the negative correlation confirms the assumption that women with higher weight enter menopause at an older age.

The relationship between the BMI value and the degree of bone deterioration (osteoporosis or osteopenia)

The correlation coefficient $r = -0.2218$ expresses only a weak dependence. The negative value confirms that as the BMI value increases, the degree of bone damage decreases.

Table 4 Occurrence interval by value σ

	σ		2σ	
Weight	59,6	88,1	45,4	102,3
Onset of menopause	44,7	53,9	40,1	58,5
r	-0,0671			

r- correlation coefficient

The relationship between BMI value and the onset of osteoporosis or osteopenia

We verified the dependence between the observed characteristics using the χ^2 test at a significance level of 0.05. We present the measured and expected values in the following tables (5,6). CHITEST in the EXCEL program was used for verification.

The result value of CHITEST is the probability value $p = 1.3890E-07 < 0.05$. When monitoring the relationship between BMI values and the onset of both osteopenia and osteoporosis, dependence was confirmed (Table 6).

Dependence between the onset of osteoporosis or osteopenia and dairy food intolerance

From the total set of 650 female respondents, only 21 reported intolerance to dairy food (3.23%). There is no dependency between the observed characters. The onset of osteopenia or osteoporosis is not conditioned by intolerance to dairy food. The resulting probability value is $p = 0.6652 > \alpha = 0.05$. Intolerance to dairy food has not been proven to be a possible factor influencing the onset of Weight 59,6 88,1 45,4 102,3 observed bone structure damage (Table 6).

The influence of individual factors tested separately in relation to the monitored diagnoses is in the zone of weak dependence. Within the given collection, the age of menopause onset was the only parameter that entered the zone of addiction acceptance.

Table 5 Measured values, frequency distribution according to BMI

Measured	Damage			Trend
BMI	0	1	2	n age
<23,9	12	81	53	146 48,8576
24-28,9	36	136	61	233 49,7518
29-38,9	71	121	57	249 49,2289
>39	11	7	4	22 48,0476
Σ	130	345	175	650

Table 6 Values of coefficients – EXCEL program output - data analysis - regression

	Coefficient	Standard deviation	t Stat	P-value	Lower 95%	Higher 95%
Interception	4,9	3,863	1,286	0,199	-2,62	12,55
Age	0,0001	0,007	0,019	0,984	-0,01	0,013
Height	-0,0099	0,023	-0,44	0,662	-0,05	0,034
Weight	-0,0071	0,024	-0,29	0,775	-0,05	0,041
Menopause in years	0,013	0,006	2,26	0,024	0,002	0,026
Dairy food tolerance	-0,079	0,143	-0,56	0,579	-0,36	0,202
Smoking	-0,0620	0,082	-0,76	0,448	-0,22	0,099
Hormonal therapy	0,0630	0,079	0,796	0,427	-0,09	0,219
BMI	-0,0172	0,064	-0,27	0,785	-0,14	0,108

Discussion

In the conducted study, we verified the effect of selected factors on bone tissue remodeling in postmenopausal women.

The results of the conducted study show that the incidence of postmenopausal bone tissue remodeling increases with the increasing age of women. The basic numerical characteristics of the group are presented in Tables 1 and 2. Some authors mention the young age of women at the onset of menopause as a risk factor for the development of osteoporosis (3). The increasing menopausal age in connection with the increasing incidence of osteopenia and osteoporosis is also reported by Agrawal et al. (1) and Veiga Silva et al. (11). According to Karlamangla et al. (5), there is a rapid loss of bone mass in the first three years from the date of the last menstrual period.

In respondents with an artificially induced onset of menopause after ovariectomy or hysterectomy, we noted a more frequent occurrence of osteoporosis. However, this increase is not statistically significant. We present the results of the t-test in Table 6. The age related to the occurrence of ovariectomy and hysterectomy is only marginally statistically related to the occurrence of osteopenia and osteoporosis in the set of respondents.

From the research results, it follows that

women with higher weight enter menopause at an older age. Weak dependence was confirmed (Tables 3 and 4).

When monitoring the relationship between BMI values and the onset of osteopenia or osteoporosis in our group, a negative dependence was confirmed. An important factor is the fact that estrogens are soluble in fats (2), so it is assumed that the rate of bone damage decreases with increasing BMI values in our group (Table 5). Opinions differ on higher BMI values as a protective or moderating factor in the development of postmenopausal osteoporosis (12). According to the authors Tian et al. (2017), there are significant age, gender and race differences in the risk of osteoporosis and the composition of fat mass (13). Higher weight, BMI and body type have a protective effect on bone remodeling according to Török-Oance et al. (2) and Veiga Silva et al. (11). According to Aghaei et al., a low BMI value is also a risk factor associated with bone mass loss (8). Guiming et al. (10) reports higher age, a higher number of pregnancies and also higher BMI, as the risks of developing postmenopausal osteoporosis in Chinese women.

In our research, intolerance to dairy food did not prove to be a significant factor affecting the onset of observed damage to bone structure.

According to Payer et al. (2007), female smokers have an accelerated catabolism of en-

ogenous estrogens, and therefore menopause occurs earlier in female smokers (6). In the set of respondents examined by us, this factor was not confirmed as statistically significant (Table 5). According to Agrawal et al. (1), a healthy lifestyle (diet, exercise and exposure to sunlight) can have a fundamental positive effect on bone health. These public health measures are recommended for the general population because they are effective, safe and cost-efficient. The management of organizations can provide various prevention options in this area within the framework of benefits (14).

Conclusion

The conducted study demonstrated a higher prevalence of osteopenia than osteoporosis and confirmed that older age and menopause are risk factors for both outcomes, i.e., for both osteopenia and osteoporosis. A BMI above 25 is a slightly protective factor from the point of view of the development of osteopenia or osteoporosis. Osteoporosis is a major public health problem associated with evident sickness and socio-economic burden. According to the Slovak Arthroplasty Register, the number of patients suffering from this disease is constantly increasing in today's fast-paced times. Patients with this disease suffer from pain and limited mobility of the hip joint. These symptoms greatly affect their lives and their level of self-sufficiency (15). Early detection can help reduce fracture occurrence rates and the overall socio-economic burden. The presented study was carried out on the basis of screening results of bone density measurements in women in the postmenopausal period of life. It was aimed at revealing the determining factors responsible for the pathological remodeling of bone tissue in the studied sample of respondents. In this context, a wider public awareness of the possibilities of preventive densitometry measurement in postmenopausal women is needed.

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