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Long-term effects of reproductive period on mineralized tissues (bones and teeth) in peri- and postmenopausal women

Abstract

Introduction. Reproductive period in women begins with the occurrence of the first menstruation and ends with the cessation thereof. The latter occurs at different age of women, depending on many factors such as race, geographical or living conditions and so on. At this time, many processes affect the condition of mineralized tissues in a woman's body.

Aim. The aim of the study was to investigate the influence of reproductive period (fertility, lactation, age of menopause) on the parameters of bone tissue and hard tissues of teeth in peri- and postmenopausal women.

Material and methods. The study involved 112 women aged 45-74 years. There was conducted a survey and a clinical study. Patients were asked about the number of pregnancies and offspring, the duration of lactation in case of each child, the age at which the menopause occurred. Periods of pregnancies and lactation were recorded in months. The bone mineral density, the number of teeth present in the mouth were also evaluated, and the DMFT index was calculated.

Results. In the studied groups of women a significant correlation between the bone mineral density and the T-score and the age at which menopause occurred was observed. Also, a significant correlation between the number of offspring and the number of the DMFT index, the number of offspring and component MT of the DMFT index and the number of offspring and the number of teeth present in the mouth during the study. A significant positive correlation between the duration of pregnancies and lactation and the DMFT index, the component MT and the number of teeth present in the mouth during the study, was observed.

Conclusions. In the studied population of peri- and postmenopausal women, a possible impact of reproductive period on the parameters of the state of the bones and teeth – the longer the total duration of pregnancy and breastfeeding and early age of onset of menopause concerned worse parameters of mineralized tissues – with the higher number of DMFT index and lower bone mineral density were observed.

Keywords: dental caries, dental prophylaxis, health care.

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INTRODUCTION

The progress in medicine has significantly contributed to increasing life expectancy. Throughout human life, functioning of the body is controlled by the hormones, the activity of which undergoes multiple changes. The reproductive period in women begins with the occurrence of the first menstruation and ends with the cessation thereof. This occurs to women of different ages, depending on many factors like race, geographical conditions, living conditions and so on. Currently, in Poland the reproductive period ranges between 13 and 49 years of age [1]. At this time, many processes affect the condition of mineral density of hard tissues in a woman's body. Numerous research studies were conducted looking at changes in the bone turnover marker and bone mineral density levels in pregnant women and during breastfeeding and after the cessation of lactation [2]. Long-term effects of pregnancy and lactation on the bones and the teeth are not confirmed by many research studies. The last period of turbulent changes, which constitutes a transitional stage between the reproductive period and the beginning of aging, is the menopause. Usually, it occurs to women aged 43-55. Menopause happens due to the expiration of ovarian function. The estrogen levels in the blood are lowered and some characteristic symptoms occur. Hormonal changes develop gradually over the years before the onset of menopause [3]. Estrogen deficiency causes changes in many organs of the body, including the mouth, and may relate to, inter alia, bone tissues of masticatory organ and teeth. Bone is a labile tissue being a subject to constant changes. Throughout individual life, resorption and apposition processes occur alternately. With age, inhibition of bone formation occurs, and porosity and thinning of cortical bone take place. Bone loss is 3% per decade over the age of 40, and increases to 9% per decade in women during menopause [4-6]. This also leads to huge losses in the alveolar bone. Tooth loss and osteoporosis, which can affect both cortical and trabecular bones, play an important role in the loss of jaw bones [7]. Osteoporosis currently being considered a civilization disease, occurs in 11% of the population [8] and concerns already 75 million people in Europe, the United States of America and Japan. The disease affects up to 30% of women aged 50+ all around Europe. In Poland, according to estimates, it affects about 3 million

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people. It is called the "silent thief of the bones" because for a long time it goes asymptomatically, and often the first symptom is bone fracture [9]. In 1994, WHO experts defined osteoporosis as "a systemic disease of skeleton characterized by low bone mass, impaired microarchitecture and increased fragility". In 2001, scientists from the National Osteoporosis Foundation (NOF) and the National Institutes of Health (NIH) formulated a new definition, according to which it is a "disease of the skeleton characterized by compromised bone strength, which increases the risk of fracture" [10]. For science, an important task is to determine the moment when the physiological process of reducing bone mass becomes pathology. Achieving the so-called peak bone mass at about 30 years of age is a turning point from which the involution processes in the bones begin. Hormonal changes can only accelerate this process. Risk factors for osteoporosis include an early menopause (before 45 years of age), old age, genetic predisposition, white race, low intake of calcium and vitamin D3 in the diet, smoking, little active lifestyle. Osteoporosis is a disease that engages doctors of various specialties. Recently, the role of a dentist has become important. The dentist is emphasized as a person capable of diagnosing osteoporosis in patients during routine dental examinations. Changes in teeth that occur with age are the least tangible, and their causes are difficult to distinguish: whether they are related to physiological wear of teeth progressing with age, or whether they result from pathological processes taking place within them.

AIM

The aim of the study was to investigate the influence of reproductive period (fertility, lactation, age of menopause) on the parameters of bone tissue and hard tissues of teeth in peri- and postmenopausal women.

MATERIAL AND METHODS

The study involved 112 women aged 45-74. Both a survey and a clinical study were conducted. Patients filled out a questionnaire with questions regarding their reproductive period. They were asked about the number of pregnancies and offspring, the duration of lactation in case of each child, the age at which the menopause occurred. Periods of pregnancies and lactation were recorded in months. The bone mineral density, the number of teeth present in the mouth were also evaluated, and the number of DMFT was calculated. The results were statistically analyzed. Measurements of bone mineral density by DEXA method were performed in the L2-L4 spine using a densitometer Lunar Prodigy Advance GE Healthcare. Based on the obtained values of bone mineral density, assuming WHO criteria, the respondents were divided into three groups:

- control group (I) – 23 women with a T-score ≥-1.0
- the group with osteopenia (II) – 38 women with a T-score <-1.0 and >-2.5
- the group with osteoporosis (III) – 51 women with a T-score ≤-2.5

RESULTS

General characteristics of the study population due to the characteristics of bone tissue

An analysis of fertility in all groups confirmed a high percentage of women who had at least one child. Nulliparous women constituted 8.7% in the control group, 18.4% in the osteopenic women and 7.8% in individuals with osteoporosis. In the studied population, the highest number of offspring was observed in the group with osteoporosis -2.04; the values in other groups were similar, and amounted to 1.96 children in the control group and 1.87 in the group with osteopenia. Breastfeeding in the first period of their children's lives was reported by 87% of women in the control group, 76.3% of women with osteopenia and 82.4% of women with osteoporosis. The studied groups did not differ significantly in this respect. There were no significant relationships regarding the duration of breastfeeding. Women with osteopenia reported the longest average periods of breastfeeding (8.93 months), and it was the shortest in the control group (6.45 months). While analyzing the age of menopause in the studied population, similar average values and medians between groups were found with the lowest average age (48.8 years) was observed in the group of women with osteoporosis. Average time in years that elapsed since menopause was the shortest in the control group (5.7), the longest in the group of women with osteoporosis (11.6). The differences were significant (Table 1). The lowest mean DMFT index was observed in the control group (22.52), while the DMFT index for women with osteoporosis and osteopenia was similar (25.39 and 25.37 respectively). The difference in the mean value of DMFT between the analyzed groups was significant (Table 2). The analysis of the individual components of DMFT index confirmed that in all groups surveyed, the highest average values concerned the component MT and the lowest was DT. The average number of MT was 11.35 in the control group, 14.21 in the group with osteopenia and 16.67 in the women with osteoporosis, and the number of DT for the group I – 1.6, in the group II – 2.29 and in the group III – 1.61. The range for MT was 1-31, the range of number of DT was 1-14

TABLE 1. Mean time (in years) after menopause.

Examined group	Time (in years) after menopause						Statistical Analysis
	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile	Range (Min-Max)	
I	5.7	6.49	3	1	10	0-23	
II	7.3	6.76	5	2	12	0-25	H=14.15 p=0.0008
III	11.6	7.58	9	5	18	0-30	

H – Kruskal-Wallis test
p – Statistical significance

I – Control Group
II – Osteopenic Group
III – Osteoporosis Group

TABLE 2. DMFT index in examined groups.

Examined group	DMFT index						Statistical Analysis
	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile	Range (Min-Max)	
I	22.52	5.18	21.00	19.00	26.00	15.00-32.00	
II	25.37	3.86	25.00	24.00	28.00	14.00-32.00	H=7.05 p=0.03
III	25.39	4.46	26.00	23.00	28.00	12.00-32.00	

in the overall population. The relationships between the groups in the number of MT were significant (Table 3). During the intraoral examination, the number of teeth present in the mouth of each woman of the study population was recorded. The number of teeth present in the mouth during the study ranged from 1 to 29. The highest average number of teeth in the mouth was found in the control group – 19.35, in the group of respondents with osteopenia – 17.74, and in individuals with osteoporosis – 14.43 teeth. These differences were significant (Table 4).

Correlations between the parameters of the hard tissues of bones and teeth and the factors of reproductive period

In the studied groups of women, a significant correlation between the bone mineral density (in grams per cm^2) and the T-score and the age at which menopause occurred (R=0.02, p=0.04) were observed. A significant correlation between the number of offspring and the number of the DMFT index (R=0.213, p<0.05), the number of offspring and component MT of the DMFT index and the number of offspring and the number of teeth present in the mouth during the study were also confirmed. The effect of the total duration of pregnancies and the duration of breastfeeding of each child (in months) on the parameters of the hard tissues of bones and teeth was also studied. A significant positive correlation between the duration of pregnancies and lactation and the DMFT index, the component MT and the number of teeth present in the mouth during the study, was observed (Table 5).

TABLE 3. Component MT (missing teeth) of DMFT index in examined groups.

Examined group	Component MT (missing teeth) of DMFT index						Statistical Analysis
	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile	Range (Min-Max)	
I	11.35	6.94	11.00	5.00	14.00	2.00-31.00	H=7.31 p=0.03
II	14.21	7.45	14.00	6.00	19.00	2.00-29.00	
III	16.67	7.91	16.00	10.00	24.00	1.00-29.00	

TABLE 4. Number of present teeth in oral cavity of examined population of women.

Examined group	Number of teeth present in oral cavity						Statistical Analysis
	Mean	Standard Deviation	Median	Lower Quartile	Upper Quartile	Range (Min-Max)	
I	19.35	6.04	21.00	18.00	24.00	1.00-26.00	H=7.61 p=0.02
II	17.74	7.37	18.00	13.00	26.00	3.00-28.00	
III	14.43	7.88	16.00	7.00	20.00	0.00-29.00	

TABLE 5. R-Spearman correlation results for parameters connected with reproductive period.

Parameters		R-Spearman	P level
Age at which the menopause occurred	Bone mineral density	0.196	p<0.05
Number of children	Component MT of DMFT index	0.230	p<0.05
Number of children	DMFT index	0.213	p<0.05
Number of children	Number of teeth	-0.200	p<0.05
Periods of pregnancies and lactation (in months)	Component MT of DMFT index	0.247	p<0.05
Periods of pregnancies and lactation (in months)	DMFT index	0.259	p<0.05
Periods of pregnancies and lactation (in months)	Number of teeth	-0.207	p<0.05

DISCUSSION

The long-term research shows that both the age at menopause and the time that elapsed since then have an influence on the development of osteoporosis in women. What matters, is the course of the entire procreative period from the onset of menarche to menopause. Important elements of this period are the number of offspring and breast-feeding. Gallagher and other authors [11,12] emphasize the influence of early menopause on the bone mineral density reduction. Francucci et al. [13] believe that it is not the age at which menopause occurred, but rather the time that elapsed since it occurred that is more important. In our material, there was no significant difference between the groups with regard to the occurrence of menopause before the age of 45 and analyzing the average time in years that has elapsed since menopause, in the control group it was the shortest – 5.7 years and the longest in the group with osteoporosis – 11.6 years. Seeman et al., [14] do not see a direct link between early menopause and low bone mineral density, but they highlight the possible impact of the age at which the menopause started on the incidence of low-energy fractures (with normal BMD values). The vast majority of authors reported a decrease in BMD after pregnancy and lactation [15,16]. Increased bone turnover with a predominance of resorption processes, which is reflected in the concentrations of markers of this process, is also characteristic for this period [16,17]. However, the decrease in bone mass during pregnancy and lactation does not imply an increased risk of osteoporosis in the future [18] or an increased risk of fractures in the postpartum period [19]. Cases of "idiopathic osteoporosis in pregnant" occurring during pregnancy are self-cured after lactation [20]. Some authors also note that even a greater number of pregnancies and births (>4) and a long period of breastfeeding (over two years) are not an increased risk of osteoporosis and low energy fractures [21]. Hillier et al. [22] recognize the positive impact of fertility and associate it with a reduced risk of fractures and osteoporosis in the future. Cure-Cure et al. [23], Nguyen et al. [24] and Michaelsson et al. [25] immediately jump to similar conclusions. In our study, no significant differences were found between fertility and duration of lactation in the three analyzed groups of women. Similarly, Sharami et al. in their research did not notice any relationship between having biological offspring and lactating and bone mineral density of women [21].

Another aspect, which is discussed is the assessment of the impact of the reduction in bone mineral density and the causal factors for the condition of the hard tissues of the teeth and dental caries in relation to osteoporosis [26,27]. Bałczewska [26] attempted to analyze the frequency and severity of dental caries based on the DMFT index what was confirmed in our findings – significant differences between the studied groups. The analysis of each component revealed that the greatest differences between the groups were in the range of component MT, while the average values of the other components: DT and FT in all three groups were similar. Kutchur and Goss [27] obtained similar results in terms of the average DMFT index, but not the individual components. The differences between the results of their analyzes could result from a different methodology – in the calculation of the DMFT index, panoramic X-ray photographs were used and not just clinical assessment of teeth during the examination of the patient.

Loss of alveolar bone, loss of epithelial attachment and loosening of teeth which are the causes of teeth loss are other problem for people with osteoporosis [4,26,28-30]. Drozdowska et al. [28] in a survey of 67 postmenopausal women observed a significant relationship between the BMD of the proximal femur measured by DEXA method and the number of teeth present in the mouth of the respondents. Similar results were obtained by Kribbs et al. [29] comparing the number of lost teeth in groups of healthy individuals, those with osteopenia and osteoporosis. The average largest number of lost teeth was reported in patients with osteopenia and the lowest in the control group.

CONCLUSIONS

In the studied population of peri- and postmenopausal women, a possible impact of reproductive period on the parameters of the state of the bones and teeth – the longer the total duration of pregnancy and breastfeeding, and early age of onset of menopause concerned worse parameters of mineralized tissues – with the higher number of DMFT index and lower bone mineral density.

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