9. Summary

Osteoporosis is an illness that is becoming an increasing health, social and economic problem in Poland and in the world. The loss of bone mineral density is influenced by numerous factors, both dependent on lifestyle and independent of it. Insufficient attention is still paid to the prevention of osteoporosis and non-farmacological methods of slowing down the loss of mineral bone density, such as a proper diet and regular physical activity, Women in the perimenopausal period are particularly vulnerable to the development of osteoporosis. Therefore, it is vital that their diet contains the adequate supply of protein and such minerals and vitamins as i.a. calcium, magnesium, phosphorus and vitamin D. The proportion of these components is often determined by the type of diet. In particular, the impact of a vegetarian diet on bone mineral density in women around and after menopause has not been documented in any Polish clinical trials.

The main aim of this doctoral thesis is to analyze selected risk factors for the development of bone mineral density disorders in women before and after menopause. The specific objectives include:

- assessment of the hip bone mineral density and spine mineral density in women before and after menopause;

- assessment of the hip bone mineral density and spine mineral density in women before and after menopause, depending on the followed diet: traditional or vegetarian;

- analysis of the effect of anthropometric parameters on bone mineral density in women before and after menopause;
- analysis of the impact of diet as well as the content of individual nutrients and minerals on bone mineral density, depending on the diet: traditional or vegetarian;
- analysis of other risk factors for osteoporosis (both lifestyle-dependent and independent of it) and their effect on bone mineral density in women before and after menopause, with particular emphasis on physical activity;

- analysis of the correlation between the vitamin D3 concentration in the blood serum and the assessed parameters of bone mineral density.

The presented study comprised 133 women aged over 45, 28% (n=37) of whom were pre-menopusal and 72% (n=96) after menopause. All patients underwent a densitometric examination of bone mineral density using the DEXA method, a body composition analysis using the BIA method, and a blood serum vitamin D3 test, In order to determine the impact of diet on the bone structure in women in the perimenopausal period, the patients' nutrition model was determined: 81 women had a vegetarian diet, whereas 52 – traditional. The subjects completed a lifestyle questionnaire, with particular emphasis on the factors affecting the occurrence of bone loss according to FRAX (WHO 2008) and kept a 3-day consumption diary based upon regular records. The obrained results were then statistically evaluated by means of the Shapiro-Wilk test, the T-Student test, and the Mann-Whitney U test. The relationships between the examined features were checked using the Sperman's rank correlation coefficient. Significant results were those that were $p<0,05$.

Statistically significant differences were established in bone mineral density in women before and after menopause. Factors adversely affecting bone mineral density in the studied women included low fat content and BMI, and in case of pre-menopausal women – also low total protein supply in their diet. A higher percentage of adipose tissue in the body correlated positively with the mineral density of the hip bone and spine in postmenopausal women ($p <0.001$). In contrast, higher BMI correlated positively with the mineral density of the hip bone in women before ($p = 0.013$) and after menopause, and the spine only in postmenopausal patients ($p <0.001$).

Insufficient vitamin D3 level in blood serum was revealed in all the studied groups of women and attributed to its low supply in diet and inadequate supplementation. The concentration of vitamin D3 did not significantly correlate with bone mineral density in postmenopausal women, but pre-menopausal women showed positive correlations that were close to statistical significance ($p = 0.078$).

Osteopenia in the hip bone was found in 38% (n = 31) of women on a vegetarian diet and 35% (n = 18) subjects on a traditional diet. Osteoporosis in the hip bone was shown only in 4% (n = 3) of women on a vegetarian diet and 2% (n = 1) of women on a traditional diet. Differences between both groups were not statistically significant.

In the study of spinal bone density, as much as 37% (n = 29) of women on a vegetarian diet and 27% (n = 14) on a traditional diet had osteopenia. Osteoporotic changes in the spine occurred in 14% (n = 11) of vegetarians and 8% (n = 4) of women on a traditional

diet. There were no statistically significant differences between women on a vegetarian diet and those following a traditional one.

The analysis of the types of diet the subjects used (vegetarian and traditional) revealed statistically significant differences among pre-menopausal women concerning the types of protein consumed(plant and animal), as well as the supply of cholesterol and polyunsaturated fatty acids, carotene, vitamins: E, B_1, PP, B_6, and sodium. The differences among post-menopausal women referred to the types of protein (plant and animal), total protein intake, cholesterol, saturated fatty acids, polyunsaturated fatty acids, carotene, retinol, vitamins: A, E, B_2, B_{12}, PP and D, folic acid, sodium, and magnesium.

Women both before and after menopause consumed too much saturated fatty acids (especially those on a traditional diet), sodium and phosphorus. The examined women were characterized by insufficient supply of calcium, vitamin D, folic acid, and – in case of women on a vegetarian diet – vitamin B_{12}. However, all this did not lead to any differences in bone mineral density between women on a vegetarian diet and those who had a traditional diet.

No statistically significant differences were found in the evaluation of other assessed BMD risk factors (physical activity and stimulants, ie coffee, alcohol, cigarettes) in women before and after menopause.

The obtained results indicate the necessity of nutritional and health education aimed at improving the quality of nutrition and reducing the occurence of other risk factors for the development of bone mineral density disorders among women in the perimenopausal period.