Introduction

Osteoporosis refers to one of the worldwide problems, due to the complications associated with it, such as fractures, which increase morbidity, disability and mortality among people. A special risk group for osteoporosis are women in the postmenopausal period.

70-75% of bone strength provides bone mineral density (BMD). According to the literature data weight closely positively correlated with the latter, in particular, due to the effect of relative hyperestrogenemia. On the one hand high body mass index (BMI) is associated with normal BMD values, on the other increases the risk not only falling, but the worse of fractures recovery. At the risk of fractures affects not only strength, but also the quality of the bone tissue. These conditions are linked, but the latter also depends on the structural architecture of the bone, the properties of its components (composition of minerals, orientation and connections fibrils of collagen, the presence of cracks and microtraumas).

Much attention of scientists was paid to the problem of metabolic syndrome (MS) as a cause of cardiovascular, endocrine and respiratory systems complications, the risk of cancer, etc., since the end of the twentieth century. The relationship between the components of metabolic syndrome (the leading of them is obesity) and bone tissue are contradictory, according to the literature data. Several researchers point to a positive impact of MS on BMD and protective effect against fractures, while others reveal conflicting data. The above has led to the present investigation

Objective. The aim of our study was to evaluate bone mineral density, trabecular bone score (TBS) and frequency of the low-energy fractures in women with obesity and metabolic syndrome

Materials and Methods

We had made a retrospective analysis of 651 patients case histories from the Ukrainian Scientific Medical Center of Osteoporosis (January 2009 – January 2016) aged 50 to 79 years (mean age was 64,2 ± 7,96 years). All women were in postmenopausal period (mean duration of it was 14,96 ± 8,4 years).

We determined the anthropometric parameters: height (m), body weight (kg), body mass index (BMI), calculating the latest by the formula: BMI = weight kg/height m². The mean height was 1,6 ± 7,96 m, the mean weight was 75,8 ± 13,7 kg, BMI - 29,5 ± 0,2 kg/m². The study did not include women who took medications or had diseases that can have influence on bone tissue.

Patients were divided into three groups. The first group (396 persons) contained women without a history of low-energy fractures (WF). The rest 255 of the patients were included into the groups of low-energy fractures. The group of women with vertebral fractures in the history (VF) contained 60 individuals. Another one involved 195 women with non-vertebral fractures (NVF) in the past. Groups were comparable for age, weight and duration of menopause. Additionally, patients were divided into subgroups of people without obesity (BMI ≤ 29.9 kg / m2) and MS (CG), with obesity (BMI≥30,0 kg/ m²) (OB) and with metabolic syndrome (MS) (the diagnosis was
verified according to the criteria recommended by the IDF, 2005). BMD was determined by X-ray densitometer (DXA) “Prodigy” (GE Medical systems, Lunar, model 8743, 2005p. CIIIA). The trabecular bone score (L1-L4) was assessed using indicator TBS, which was determined using methods TBS iNight (Med-Imaps, Pecass, France). Statistical analysis was performed using Statistica 6.0. Results were present as means (±SD) and categorical variables were expressed as frequencies. A two-tailed p value of < 0.05 was considered to be significant. Associations between continuous variables were examined by Pearson correlation coefficient. ANOVA was used to examine differences among the groups for different variables.

**Results**

The main clinical, anthropometric, laboratory investigations were comparable between three groups of patients. We found some significant differences in women of different subgroups. The mean values of the weight and BMI were significantly higher in the OB subgroup of patients in compare with CG and MS subgroups (p<0.001) and in the MS subgroup of women were higher than in the CG one (p<0.001). Triglyceride mean value was the highest and high-density lipoproteins mean value was the lowest in MS subgroups of the patients.

It was analyzed BMD and TBS depending on the presence of fractures in patients of different groups.

We didn’t found significant differences of BMD at the lumbar spine (L1-L4), femoral neck, radius 33% regions (p>0,05) between all groups of the patients. It was estimated significantly lower BMD at total mean (p<0,05), trochanter (p<0,05) and ultra-distant radius (p<0,001) regions in NVF group of women (0,864± 0,128; 0,716±0,123; 0,369±0,077, respectively) in compare with WF one (0,900±0,163; 0,750±0,145; 0,394±0,092, respectively). There was not significant differences of BMD data between WF and VF, VF and NVF groups of patients (p>0.05).

The study found that BMD is significantly higher in all areas of the skeleton in OB and MS subgroups of patients compared to women without obesity (tabl.1).

**Table 1**

<table>
<thead>
<tr>
<th>Groups of the patients</th>
<th>BMD (g/cm²) on the level of</th>
<th>Subgroups of the women</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar region (L1-L4)</td>
<td>CG (n=325)</td>
<td>OB (n=192)</td>
<td>MS (n=134)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.925± 0.179</td>
<td>1.099± 0.199</td>
<td>1.126± 0.189</td>
<td>48,11</td>
</tr>
<tr>
<td>Femur neck</td>
<td>0.771± 0.119</td>
<td>0.866± 0.140</td>
<td>0.884± 0.142</td>
<td>30,03</td>
</tr>
<tr>
<td>Total mean</td>
<td>0.822± 0.132</td>
<td>0.964± 0.159</td>
<td>0.985± 0.149</td>
<td>53,26</td>
</tr>
<tr>
<td>33% radius</td>
<td>0.684± 0.123</td>
<td>0.800± 0.118</td>
<td>0.779± 0.101</td>
<td>41,99</td>
</tr>
</tbody>
</table>
### Conducted regression analysis between BMD (lumbar region (L1-L4), femoral neck) data and body weight of the patients showed a significant possible relationships between these parameters in all cohort of women (r=0.461; p<0.001 and r=0.300; p<0.001, respectively). This significant positive relationship was maintain in all groups and subgroups of the patients.

Comparison of TBS between women showed significant lower rates in patients of MS subgroup in a case of presence of vertebral fractures in compare to those without fractures in past. Other significant differences of TBS data between examined groups and subgroups were not found.

Regression analysis between TBS data and body weight of the observed individuals showed the significant negative impact of body weight and TBS in all cohort of patients and CG subgroup (r=-0.0889; p<0.0243 and r=-0.0889; p<0.00010, respectively). In patients of OB and MS subgroups significant differences were absent.

We had calculated the percentage of vertebral and non-vertebral fractures in past in subgroups of patients. Low-energy vertebral fractures occurred most frequent (13%) in MS group of the patients in compare with CG and OB groups (9% and 7%, respectively). Non-vertebral fractures were estimated in 32% of CG women and in 26% of OB and 30% of MS one.

Evaluation of statistical significance frequency of fractures due to low-energy trauma patients examined groups was performed using non-parametric test definition $X^2$.

The frequency of vertebral fractures and non-vertebral fractures did not differ significantly in the subgroups of CG and OB ($X^2 = 0.067, p>0.05$ and $X^2 = 1.295, p>0.05$, respectively) and CG and MS ($X^2 = 2.099, p>0.05$ and $X^2 = 2.040, p>0.05$, respectively). The frequency of vertebral fractures was higher in the subgroup of women with MS compared to people subgroups OB.

Our results showed that BMD is significantly higher in all areas of the skeleton in subgroups of patients with OB and MS compared to women of CG subgroup. We confirmed the findings of

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<table>
<thead>
<tr>
<th>Group</th>
<th>Lumbar region (L1-L4)</th>
<th>Femur neck</th>
<th>Total mean</th>
<th>33% radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>VF group</td>
<td>0.870 ± 0.155</td>
<td>1.042 ± 0.147</td>
<td>1.052 ± 0.191</td>
<td>8.508</td>
</tr>
<tr>
<td>NVF group</td>
<td>0.945 ± 0.150</td>
<td>1.067 ± 0.171</td>
<td>0.997 ± 0.162</td>
<td>10.087</td>
</tr>
</tbody>
</table>

Notes: CG – subgroup of patients without obesity; OB - subgroup of patients with obesity; MS – subgroup of patients with metabolic syndrome; WF – without fractures; VF – vertebral fractures; NVF – vertebral fractures.
other researchers of positive body weight impact on BMD. However, regression analysis didn’t show differences of the probable occurrence of fractures due to low-energy trauma in the patients’ subgroups OB and MS compared to CG subgroup. This can be explained by lower TBS in the patients of MS subgroup compared with a CG subgroup of the women.

Probably more frequent fractures in the subgroup of patients with MS compared to OB requires further study different components of the MS on the incidence of fractures.

**Conclusion**

Thus, despite the fact that the BMD indexes are better in patients with obesity and metabolic syndrome it does not give them advantages in the prevention of the low-energy fractures and, they make up the risk group for their development.