



Research Article

Relationship between Body Weight, BMI and Bone Mineral Density in Patients from the Point of View of the Nurse Working in a Densitometric Clinic

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Abstract

Aim: Obesity is a well-known risk factor of diabetes, metabolic diseases, locomotor disorders and it is concomitant with menopause. Mentioned diseases are often accompanied with osteoporosis. The aim of this study was to identify the correlation of obesity and osteoporosis in wide spectrum of patients who were referred to densitometry assessment. **Method:** The retrospective study evaluated 3427 patients, referred to Densitometric assessment within one year by orthopaedist, gynaecologist, rheumatologist, and endocrinologist for suspected osteoporosis associated with the underlying disease. Densitometric of weight bearing sites was performed following the standard mode, according to ISC and WHO criteria, in order to set the Bone Mass Density (BMD). Patient's body weight was expressed by Body Mass Index (BMI). BMD to BMI were statistically compared. **Results:** BMI to BMD were found in highly significant correlation. The high BMI was accompanied with high BMD e.g. low incidence of osteoporosis and vice versa. Significance on the level $p < 0,001$ was found even among the individual BMI groups. **Conclusion:** Presented findings are in accordance with other papers, which have proven that high body weight lowers the risk of osteoporosis, occurring mainly in healthy people, respectively in menopausal women. In contrast to previous studies, our group of patients represents the wide spectrum of diseases, potentially leading to osteoporosis. Based on the findings we can conclude that the high body weight, regardless of the underlying disease, positively influences the bone development and prevents the osteoporosis. In other words, weight load on skeleton has an independent positive effect on osteogenesis, regardless of the concomitant underlying disease.

Keywords: Bone mineral density; Body mass index; Obesity; Osteoporosis; Nurse

Introduction

Obesity and osteoporosis are two significant civilization diseases threatening health of population mainly in developed countries of the world. The obesity affects practically all age groups in population; its influence on health is manifested

mostly at higher age as a risk factor of diabetes, cardiovascular diseases, etc. [1]. Moreover, the manifestation of the osteoporosis is at higher age, associated with bone fractures, which increases mortality of seniors [2,3]. Rise of incidence for both diseases could be ascribed to lifestyle and prolongation of the life expectancy. The relation between obesity and the onset of metabolic, endocrine and cardiovascular diseases is clearly approved [1].

In contrast, the relation between obesity and osteoporosis is not so unambiguous. For example, there is a question, whether overweight associated with endocrine, metabolic diseases, immobilization, etc., will result in osteoporosis because of these diseases, or as the overweight itself.

The answer lays in prevention. Key step in prevention of obesity and osteoporosis is common, physical load, exercise, but also targeted nursing education of patients. In addition, archaeological findings on bones of ancient people favour this theory. The findings showed their high density, also at high age, seemingly, thanks to physical load and nutrition. The question is, if it is relevant to consider obesity as an independent factor, body burden”, contributing to bone mineralization. This theory may be supported by results of clinical observation of women in menopause. The low weight/low body mass index BMI is the risk factor of osteoporosis and is one of the indications to densitometric assessment [3-5]. Therefore, undoubtedly the load on bones is the key factor for osteogenesis. However the open question is, whether this positive effect of body weight burden is not hindered by concomitant disorders associated to osteoporosis. The aim of this study was to compare the Bone Mineral Density (BMD) to Body Mass Index (BMI) in patients referred to densitometry, regardless of diagnosis, which was the reason for this assessment.

Material and Method

The study group represents patients assessed in Densitometric Clinic (DC), Railway Hospital Zvolen, during one year. The densitometric examination was performed by a nurse at a specialized outpatient clinic who was trained to work with the DEXA densitometer. The assessments were performed upon recommendation of medical specialists in the field of gynaecology, rheumatology, endocrinology, and orthopaedist. All DC patients were included in primary study assessment and repeatedly examined, regardless of the treatment of underlying diseases, or osteoporosis.

Gained parameters for this study were age, gender, bone mineral density (BMD) and body mass index (BMI). The study group of total 3 427 patients is presented in Table 1. Their average age is 56,8 years; there are 179 men (5,22%), with the significant predominance of women 3248 (94,78%), and with the small prevalence of urban population - 68,1%.

The spectrum of underlying diagnoses is wide and reflects the specialization of referring physicians, 1 227 patients (36%) were from orthopaedists, 1130 patients (33%) from rheumatologists, and 1036 patients (30%) from gynaecologists. Only 34 patients were sent by endocrinologists (1%).

Bone density was assessment by densitometer DEXA (dual-energy x-ray absorptiometry) – in the form of RTG absorption,

performed in two levels. Standardization of assessment was done by the COMAC BME project. Majority of examinations were conducted as a “golden standard” in the lumbar spine area and proximal femur. Except for this was conducted Peripheral densitometry but only as a screening method in the risk groups, according to the International Society for Clinical Densitometry (ISCD). For evaluation of BMD in G/cm² was used T-score following WHO criteria.

Each patient’s body parameters were measured (height, weight) and BMI was computed the standard way. Except for the stated parameters were also evaluated other health indicators; considered were the nutrition habits or osteoporosis treatment – however these went beyond the objective of the presented paper.

To reflect the size of the file, dominant female prevalence and the different ways of life was for the evaluation used statistic processing through chi-square test.

Age	Male	%/SD	Female	%/SD
Oct-20	2	1,12	0	0
21-30	3	1,68	8	0,25
31-40	7	3,91	30	0,92
41-50	26	14,53	274	8,44
51-60	59	32,96	1284	39,53
61-70	51	28,49	1108	34,11
71-80	26	14,53	505	15,55
81-90	4	2,23	38	1,17
91-100	1	0,56	1	0,03
total	179	5,22	3247	94,78
mean/SD	59,16	12,22	61,31	8,98

Table 1: The study group of patients by the age and gender.

Results

The results are summarized in Table 2, Figures 2 and 3. There is highly significant negative correlation between BMD and BMI. With increase of body weight (BMI) the incidence of osteoporosis (BMD) decreases. While in BMI category under 20 in the 0.77% of the file occurred normal BMD, with BMI 40-60 are normal values of BMD in 54,8% patients.

By evaluating Chi square tests with degrees of freedom, is significance on value less than 0,001 (***). In Figures 1 and 2 is evident that the relation between BMI and BMD is in striking negative linear correlation and the differences among individual BMI degrees are highly statistically significant – mainly in categories BMI 20-25 and 30-35 (***). Expressed in words: the higher BMI value, the lower incidence of osteopenia, respectively osteoporosis, and vice versa.

BMI	Bone Mineral Density (BMD)			Total	Statistical significance
	Normal	Osteopenia	Osteoporosis		p Total
< 20	12	69	70	151	***
20 - 25	142	526	374	1042	
25 - 30	245	734	296	1275	
30 – 35	209	353	91	653	
35 – 40	94	101	27	222	
40 - 60	46	35	3	84	
Total	748	1818	861	3427	

Table 2: Relation (correlation) BMI and BMD.

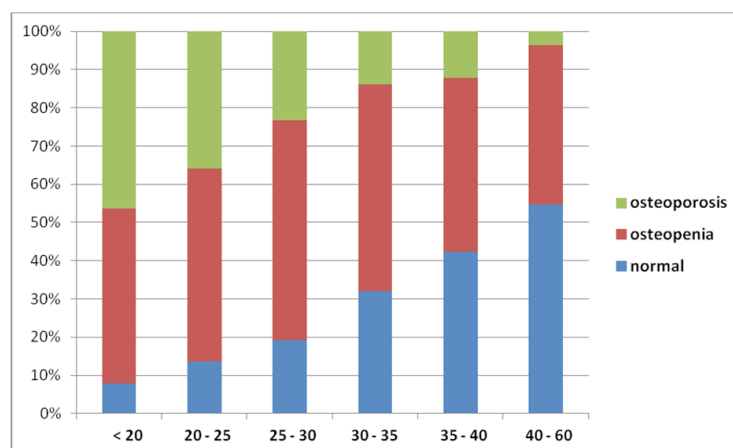


Figure 1: The percentage of BMD groups to BMI.

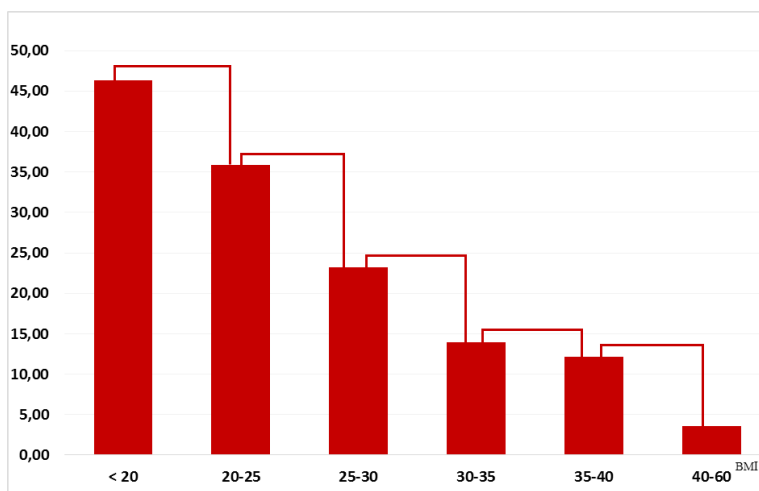


Figure 2: Statistical significance of differences in the incidence of osteoporosis among BMI groups.

Discussion

Results of the presented study, show the relation of body weight to osteoporosis, proving that overweight (high BMI) is protective and vice versa; low weight (low BMI) is a risk factor of osteoporosis. This fact was confirmed by works of other authors [4-7]. Bones and skeleton are dynamic structures not only in childhood and adolescent age. Physiologically, the quality of bones and muscles is decreasing with increasing age. Men at certain age have more muscle mass and higher BMD than women. For women the decrease of BMD is gradating after menopause. Other factors are life style – diet, physical load, all important factors for bone quality [6].

By examining relations of different factors to BMD in the file of 1 492 men and women at higher age, was found the close relation of BMD to body weight, without being affected by other factors like: the physique, age, load, alcohol, smoking or taking oestrogen. This relation was valid mainly for weight-bearing bones [4,5,8]. Another important finding is negative (inverse) correlation, proven between body weight, BMI and the risk of femoral neck fracture (hip fracture) [2,7]. Intentional or unintentional weight loss increases the risk of femoral neck fracture in older women [5]. Mentioned studies were conducted on the files of healthy people, respectively in women at postmenopausal age. However, the results are consistent with the hypothesis of protective effect of body weight, as a mechanical force influencing the skeleton [8] and the current knowledge about mechanisms for regulation of osteogenesis. To support this argument let us point to the fact that bone is a metabolically highly active tissue. Its formation and reconstruction is system controlled by mechano-apo-endocrine systems, where load deformity plays an important role [3,9]. Load stimulates osteocytes, as mechanoreceptors activating biological systems of osteoblasts and osteoclasts [10] cytoskeleton stimulates production of osein and mineralization, respectively degradation – reconstruction of bones. In the formation of inorganic component of bone mineralization – hydroxyapatite - play, except for the endocrine factors (parathormon, vitamin D, calcitonin), significant role mechano-elctric stimulation – piezoelectric effect, which activates osein mineralization, being the therapeutically used effect [11].

The question remains to what extent can be the relation - body weight : bone density - influenced by various concomitant diseases, and medications leading to osteoporosis. For instance it has been proven, that first and second type diabetes mellitus have no fundamental influence on the onset of osteoporosis [12], however authors themselves, recommend verification of these results in further studies. In the file of us presented 3427 patients, covering wide age range (Table 1), was indication for densitometric assessment the decision of a specialist physicians in the field of orthopedy, rheumatology, gynaecology and endocrinology (Figure

1), where all are associated with osteoporosis. However, even under these conditions was the relation between the degrees of overweight, expressed in BMI to BMD value, clear. The weight – meaning mechanical load on body-bearing bones – has protective influence on the onset of osteoporosis. This factor seems to be clearly independent – regardless of the presence of other comorbidity.

Conclusion

Weakness of the study is complex evaluation of the whole group of patients, not taking in consideration their diagnoses. Therefore, the correlation may not be universal and further studies are needed. In spite of that, it is obvious that each paper concerning osteoporosis should take into account body weight or BMI of studied patients. The findings can be applied in nursing care for immobile patients, but also for the recommendations of lifestyle modification.

Osteoporosis and obesity are the most common civilization diseases and from this aspect, the findings of our study, present just a partial view overall width of the issue. Just the whole set of studies can complete and expand the knowledge of the subjected issue. Anyway, the weight loss in connection to comorbidity, mainly at higher age, is possibly risky for the onset of osteoporosis.

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