

RISK FACTORS AND BONE MINERAL DENSITY IN ATHLETES AND NON-ATHLETES

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Risk factors are important aspects in the treatment of patients with lower bone mineral density (BMD).

The objective of this study was to estimate the association between risk factors and BMD status of subjects.

Forty subjects - athletes of first sub-sample, were recruited from a football club "Železničar" in Niš, while forty subjects - non-athletes of the second sub-sample, were recruited from the Faculty of Occupational Safety in Niš, totally 80 subjects of masculine sex. BMD was diagnosed by using Dual X-Ray Energy Absorptiometry (DEXA densitometer), in the lumbar region of the spinal column and region of the hip articulation, while the presence of risk factors was evaluated by the One-Minute Osteoporosis Risk Test, ie. questionnaire of the International Osteoporosis Foundation, just before the diagnostics of BMD. All subjects agreed with the terms of research, conducted in accordance with the Declaration of Helsinki.

Among 80 subjects, in six (1 athlete and 5 non-athletes) athletes osteopenia was found in the lumbar region of the spinal column, and in three (non-athletes) osteopenia was found in the region of hip articulation. Based on the results of χ^2 test, there was the association between the lack of physical activity as a risk factor and osteopenia in the lumbar region of the spinal column (BMDSPINE osteopenia), and between the lack of physical activity as a risk factor and osteopenia in the region of hip articulation (BMDHIP osteopenia), while the association significance between smoking as a risk factor and BMDSPINE osteopenia should be taken with caution, because it is approaching the critical value ($p=0.056$).

Concerning this research, the risk factors had a considerably greater impact on low BMD in non-athletes, compared to athletes, ie., in patients who are smokers and lack physical activity. *Acta Medica Medianae 2009;48(4):45-49.*

Key words: risk factors, BMD, DEXA, questionnaire, association

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Introduction

Bones develop from new binding tissue called mesenchyma which grows two types of cells, new bone cells (osteoblasts) and large bone cells (osteoclasts). Osteoblasts generate bone tissue, and osteoclasts cause decay of bone tissue. Both types of cells act continuously and simultaneously, which is important for the normal development and formation of bone tissue (1).

A complete cycle of bone remodelling lasts from two to three months. In a younger person, new bone cells are formed more rapidly and in larger quantity than the existent ones, which are reabsorbed so that the total bone mass increases. Bone mass reaches its peak in the mid

thirties (2). Osteoporosis means "porous bones" and causes feebleness and brittleness of bones, so that minimal physical activity could induce fracture (3). A low bone mineral density (BMD) can be caused by a low maximum bone mass or by very sudden bone mass loss after the completion of the maximum mass.

Factors influencing the bone density can be roughly classified into hereditary and environmental factors. Although heritage obviously influences the maximum bone mass, its role in the later bone loss is not defined. Habits as smoking and alcohol consumption are connected to the degree of the bone loss. Those interwoven relations make difficult attempts to separate the influence of heritage from the influence of the environment on the bone loss (4). Health-related quality of life (HRQOL) is an important aspect in the management of patients with osteoporosis (5).

Osteoporotic fractures are associated with significant morbidity and mortality. In addition, the declines in physical function and the changes in appearance due to fractures contribute to the severe reduction in patients quality of life (HRQOL). Some studies have also suggested that osteoporotic patients without fractures perceive a reduction in their quality of life. It has been suggested that anti-osteoporotic therapy is effective in increasing patients' HRQOL (6). In

the past, with lack of methods for measuring BMD and drugs necessary to reduce fracture risk, osteoporosis and fractures were believed to be „normal“, an untreatable part of ageing, rather than a disease. Fortunately, those days are over.

Aims

The objective of this study was to estimate the association between risk factors and bone mineral density in athletes and non-athletes.

Material and methods

Forty subjects - athletes of first sub-sample, aged 22.52 ± 4.01 years, height 179.77 ± 5.63 cm, body mass 73.65 ± 6.46 kg (mean \pm stdev), were recruited from a football club "Železničar" in Niš, while forty subjects - non-athletes of the second sub-sample, aged 22.85 ± 2.80 years, height 180.52 ± 6.11 cm, body mass 80.61 ± 14.72 kg (mean \pm stdev), were recruited from the Faculty of Occupational Safety in Niš, totally 80 subjects of male sex.

Measurements of body height, body weight and bone mineral density were performed in the Institute for Prevention, Treatment and Rehabilitation of Rheumatic and Cardiovascular Disease "Niška Banja". BMD was diagnosed by using Dual X-Ray Energy Absorptiometry (DEXA densitometer), in the lumbar region of the spinal column and region of the

hip articulation. The accuracy and reproducibility of this instrument amounts to 1% (7). The obtained data were processed by Lunar Software. Absolute values of BMD were obtained, reported in g/cm² for each examined vertebra, mean values of vertebra density L1-L4 were reported in absolute values (g/cm²). Values which were \pm one standard deviation upon 100% of values, i.e. \pm 12%, were conceived normally.

Risk factors were evaluated with the One-Minute Osteoporosis Risk Test (see appendix), ie. questionnaire of the International Osteoporosis Foundation (8), just before the diagnostics of BMD. All subjects agreed with the terms of research, conducted in accordance with the Declaration of Helsinki. Chi-squared test was used for checking the risk factors associated with low BMD.

Results

Osteopenia was confirmed in six subjects (one athlete and five non-athletes) in the lumbar region of the spinal column, and in three subjects (non-athletes) in the region of hip articulation (Table 1).

All risk factors, with exception of family case history and use of corticosteroids, were more present among non-athletes, compared to athletes (Table 2).

Table 1. Descriptive statistics of BMD variables, upon examination in the lumbar region of the spinal column and region of the hip articulation

Variables		Valid N	Mean	Std. Dev.	Std. Error Mean
bmdspine osteopenia ($0.92\text{g/cm}^2 \leq \text{bmd} \leq 1.10\text{g/cm}^2$)	0	74	1.3404	0.11480	0.01334
	1	6	1.0188	0.04010	0.01637
bmdhip osteopenia ($0.77\text{g/cm}^2 \leq \text{bmd} \leq 0.96\text{g/cm}^2$)	0	77	1.3208	0.13861	0.01580
	1	3	0.8753	0.07836	0.04524

Tabela 2. Deskriptivna statistika faktora rizika kod sportista i nesportista

Athletes			Non-athletes		
RISK FACTORS	NE	DA	RISK FACTORS	NE	DA
family case-history	31	9	family case-history	38	2
dowager's hump	40	0	dowager's hump	40	0
age \geq 40	40	0	age \geq 40	40	0
fracture	33	7	fracture	27	13
fall_fear	40	0	fall_fear	40	0
loss in height >3cm	40	0	loss in height >3cm	40	0
BMI <19 kg/m ²	39	1	BMI <19 kg/m ²	39	1
corticosteroids	39	1	corticosteroids	40	0
rheumatoid arthritis	40	0	rheumatoid arthritis	40	0
thyroid/parathyroid	40	0	thyroid/parathyroid	40	0
low testosterone	40	0	low testosterone	40	0
alcohol	40	0	alcohol	38	2
lack of physical activity	40	0	lack of physical activity	18	22
smoking	39	1	smoking	25	15
calcium avoidance	39	1	calcium avoidance	33	7
sun <10 min per day	40	0	sun <10 min per day	40	0

Table 3. Descriptive statistics ie. frequencies of subjects with and without diagnosed osteopenia in the lumbar region of the spinal column and lack of physical activity risk factor.

		lack of physical activity		Total
		not active	active	
BMDSPINE osteopenia	0	56	18	74
	1	2	4	6
Total		58	22	80

Table 4. χ^2 test, ie., the association between osteopenic changes in the region of spinal column and lack of physical activity

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.991(b)	1	0.025
N of Valid Cases	80		

a Computed only for a 2x2 table
 b 2 cells (50.0%) expected count less than 5. The minimum expected count is 1.65..

Table 5. Descriptive statistics ie. frequencies of subjects with and without diagnosed osteopenia in the lumbar region of the spinal column and smoking as a risk factor

		smoking		Total
		no	yes	
BMDSPINE osteopenia	0	61	13	74
	1	3	3	6
Total		64	16	80

Table 6. χ^2 test, ie., association between osteopenic changes in the region of spinal column and smoking as a risk factor

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square (a)	3.649(b)	1	0.056
N of Valid Cases	80		

a Computed only for a 2x2 table
 b 2 cells (50.0%) expected count less than 5. The minimum expected count is 1.20

Table 7. Descriptive statistics ie. frequencies of subjects with and without diagnosed osteopenia in the region of hip articulation and lack of physical activity as a risk factor

		lack of physical activity		Total
		.00	1.00	
BMDHIP osteopenia	ne ma	58	19	77
	ima	0	3	3
Total		58	22	80

Table 8. χ^2 test, ie., association between osteopenic changes in the region of hip articulation and the lack of physical activity

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square (a)	8.217(b)	1	0.004
N of Valid Cases	80		

a Computed only for a 2x2 table
 b 2 cells (50.0%) expected count less than 5. The minimum expected count is 0.83.

According to results of descriptive statistics (Table 3), in 56 subjects without lack of physical activity as a risk factor, osteopenia was not diagnosed, while in 2 (two) subjects without lack of physical activity as a risk factor, osteopenia was diagnosed in the lumbar region of the spinal column. In 18 subjects with lack of physical activity as a risk factor, osteopenia was not diagnosed, while in 4 (four) subjects with lack of physical activity as a risk factor, osteopenia was diagnosed in the lumbar region of the spinal column. In order to verify the existence of the association between BMD variables and risk factors, χ^2 test was used. Null hypothesis assumed the independence of two features, while the alternative one assumed their dependence.

Based on the results of χ^2 test (Table 4), the conclusion is that there is the association between osteopenic changes in the region of spinal column and the lack of physical activity as a risk factor ($p = .025$).

According to results of descriptive statistics (Table 5), in 61 subjects without smoking as a risk factor, osteopenia was not diagnosed, while in 3 (three) subjects without smoking as a risk factor, osteopenia was diagnosed in the lumbar region of the spinal column. In 13 subjects with smoking as a risk factor, osteopenia was not diagnosed while in 3 (three) subjects with smoking as risk factor, osteopenia was diagnosed in the lumbar region of the spinal column.

Based on the results of χ^2 test (Table 6), the conclusion is that there is not the association between osteopenic changes in the region of spinal column and smoking as a risk factor, but the significance is near to the critical value of significance ($p = 0.056$), so this conclusion should be taken with caution.

According to results of descriptive statistics (Table 7), in 58 subjects without lack of physical activity as a risk factor, osteopenia was not diagnosed in the region of hip articulation. In 19 subjects with lack of physical activity as a risk factor, osteopenia was not diagnosed, while in 3 (three) subjects with lack of physical activity as a risk factor, osteopenia was diagnosed in the region of hip articulation.

Based on the results of χ^2 test (Table 8), the conclusion is that there is the association between osteopenic changes in the region of hip articulation and lack of physical activity as a risk factor ($p = 0.004$).

Discussion

Concerning the lack of physical activity as a risk factor, Bubanj, S. et al. (3), found significant difference ($p = 0.00$), in BMD in the region of hip articulation in athletes (1.39 g/cm²) compared to non-athletes (1.22 g/cm²), while the difference in BMD in the region of spinal column in athletes (1.34 g/cm²) compared to non-athletes (1.30 g/cm²) was reported, but was not significant ($p = 0.23$).

According to Henderson, White & Eisman (9), there is evidence that in humans, physical exercises developed in the growing and development phases, determined a 7 to 8% of bone mass gain in adults, reducing substantially the breaking risks in advanced age. Proctor et al. (10), on the sample of 348 men and 351

women, found that physical activity declined by 34 and 38% and lean body mass declined by 18 and 17% with aging in women and men, respectively, and decreases in muscle strength have been associated with the risk of osteoporosis in women as well as men. According to Nguyen, Center & Eisman (11), in research which included 1075 women and 690 men, quadriceps strength was negatively associated with age ($p < 0.0001$) and positively related to BMI ($p < 0.0001$) and BMD ($p < 0.0001$) in both men and women.

Obtained results of the current research concerning smoking as a risk factor, are in accordance with the results of research conducted by Seeman et al. (12). Namely, according to mentioned authors, the relative risk for vertebral fractures due to osteoporosis, among 105 male patients, estimated by the odds ratio, was increased among those who smoke cigarettes (relative risk = 2.3; $p = 0.01$). In the research conducted by Hippisley-Cox & Coupland (13), there participated 1.183.663 women and 1.174.232 men aged 30-85 years in the derivation cohort. There were 24.350 incident diagnoses of osteoporotic fracture in women and 7.934 in men. Among other risk factors, smoking status was significantly associated with the risk of osteoporotic fracture in both women and men. In the study conducted by Rozental et al. (14), authors included 500 patients (331 women, 169 men) with a mean age of 67 years (range, 55-94 years) and screened them for osteoporosis. 154 patients were identified with low bone mineral density at the time of recruiting (women: 38%, men: 17%).

Osteoporosis and hypertension are two mass noninfectious diseases, the incidence of which increases with aging of the population. Early menopause, estrogen deficit, age, smoking and physical inactivity are important risk factors (15). Among other risk factors, smoking was also an independent risk factor for osteoporosis. In a large population-based study of 1068 young men, age 18.9 ± 0.6 years (mean \pm SD), Lorentzon et al. (16), reported significantly lower areal BMD, measured by dual energy x-ray absorptiometry, of the total body, lumbar spine, femoral neck, and trochanter in smokers than in nonsmokers.

Conclusion

The adjusted research considered young, male population of athletes and non-athletes, with relatively good social status. Among them, there were subjects having sustained a fracture, having a family case-history of fractures, one of them used corticosteroids, but also, a large number of them had bad lifestyle habits, which are precursors of osteoporosis. But, as osteoporosis progresses without visible symptoms (that is why it is called „silent disease“) and due to the lack of knowledge about the disease, subjects in whom osteopenia was diagnosed, were not aware of negative changes in their BMD.

The purpose of the One-Minute Osteoporosis Risk Test is to assess people with potential osteoporotic changes and improve their quality of life,

and serve as prevention in lowering the costs of further osteoporosis treatment. If subjects answered “yes” to any of questions within One-Minute Osteoporosis Risk Test, that does not mean that they have low BMD. Positive answers simply mean that they have clinically proven risk factors which may lead to osteopenia, osteoporosis and fractures.

Concerning the conducted research, the subjects and physicians should focus on increase of physical activity and avoidance of smoking..

Appendix

The NEW IOF One-Minute Osteoporosis Risk Test (questionnaire for men)

What you cannot change – your family history

1. Have either of your parents been diagnosed with osteoporosis or broken bone after a minor fall (a fall from standing height or less)? yes no
2. Did either of your parents have a “dowager’s hump”? yes no

Your personal clinical factors

These are fixed risk factors that one is born with or cannot alter. But that is not to say that they should be ignored. It is important to be aware of fixed risks so that steps can be taken to reduce loss of bone mineral.

3. Are you 40 years old or older? yes no
4. Have you ever broken a bone after a minor fall, as an adult? yes no
5. Do you fall frequently (more than once in the last year) or do you have a fear of falling because you are frail? yes no
6. After the age of 40, have you lost more than 3 cm in height (just over 1 inch)? yes no
7. Are you underweight (is your Body Mass Index less than 19 kg/m²)? yes no
8. Have you ever taken corticosteroid tablets (cortisone, prednisone, etc.) for more than 3 consecutive months (corticosteroids are often prescribed for conditions like asthma, rheumatoid arthritis, and some inflammatory diseases)? yes no
9. Have you ever been diagnosed with rheumatoid arthritis? yes no
10. Have you been diagnosed with an over-reactive thyroid or over-reactive parathyroid glands? yes no
11. Have you ever suffered from impotence, lack of libido or other symptoms related to low testosterone levels? yes no nevezanih za nizak nivo testosterona? da ne

What you can change – your lifestyle factors

Modifiable risk factors which primarily arise because of diet or lifestyle choices.

12. Do you regularly drink alcohol in excess of safe drinking limits (more than 2 units a day)? yes no
13. Do you currently, or have you ever, smoked cigarettes? yes no
14. Is your daily level of physical activity less than 30 minutes per day (housework, gardening, walking, running etc.)? yes no
15. Do you avoid, or are you allergic to milk or dairy products, without taking any calcium supplements? yes no
16. Do you spend less than 10 minutes per day outdoors (with part of your body exposed to sunlight), without taking vitamin D supplements? yes no

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FAKTORI RIZIKA I GUSTINA KOŠTANOG TKIVA KOD SPORTISTA I NESPORTISTA

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Faktori rizika predstavljaju važan aspekt u tretmanu bolesnika sa niskom koštanom mineralnom gustinom (BMD).

Cilj ovog istraživanja bio je da se utvrdi povezanost faktora rizika i BMD statusa ispitanika.

Četrdeset ispitanika – sportista prvog subuzorka, bili su članovi fudbalskog kluba "Železničar" iz Niša, dok su četrdeset ispitanika – nesportista drugog subuzorka bili studenti Fakulteta zaštite na radu, ukupno 80 ispitanika muškog pola. BMD je dijagnostifikovan korišćenjem Dvostruke X-Zračne Energetske Apsorpcionometrije (DEXA densitometrom), u lumbalnoj regiji kičmenog stuba i regiji zgloba kuka, dok je prisustvo faktora rizika procenjeno uz pomoć Jednominutnog testa rizika osteoporoze, tj. upitnika Međunarodne fondacije za osteoporozu, neposredno pre dijagnoze BMD. Svi ispitanici su se složili sa uslovima istraživanja, koje se odvijalo u skladu sa Helsinškom deklaracijom.

Među 80 ispitanika, kod šestorice (jednog sportiste i petorice nesportista) utvrđena je osteopenija u lumbalnom delu kičmenog stuba, a kod trojice (nesportista) je utvrđena osteopenija u predelu zgloba kuka. Na osnovu rezultata χ^2 testa, postojala je povezanost faktora rizika manjka fizičke aktivnosti i osteopenije u lumbalnom delu kičmenog stuba (BMDSPINE osteopenia) i faktora rizika manjka fizičke aktivnosti i osteopenije u predelu zgloba kuka (BMDHIP osteopenia), dok značajnost povezanosti faktora rizika pušenja i BMDSPINE osteopenije, treba uzeti sa predostrožnošću, s obzirom da je blizu kritične vrednosti ($p=0.056$).

Što se tiče aktuelnog istraživanja, faktori rizika su imali značajno veći uticaj na nisku gustinu koštanog tkiva (BMD) kod nesportista u poređenju sa sportistima, tj. kod bolesnika koji puše i imaju manjak fizičkih aktivnosti. *Acta Medica Medianae* 2009; 48(4):45-49.

ključne reči: faktori rizika, BMD, DEXA, upitnik, povezanost