medicinska revija
medical review

UDK: 616.71-007.234-06-055.2
616.71-001.5-055.2

Igić N. and Zvekić-Svorcan J. ■ MD-Medical Data 2016;8(2): 077-086

Originalni članci/
Original articles

RISK ASSESSMENT FOR FAIL IN PATIENTS WITH REDUCED BONE MINERAL DENSITY

PROCENA RIZIKA ZA PAD KOD PACIJENTKINJA SA SMANJENOM MINERALNOM KOŠTANOM GUSTINOM*

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* Scientific work was presented on Student's Congress of Medical Faculty of Novi Sad, March 26, 2016. Mentor: Jelena Zvekić-Svorcan TA MD, MSc

Key words
fall, reduced bone mineral density

Ključne reči
pad; snižena mineralna koštana gustina

Abstract

Introduction: Reduction in bone mineral density has consequences in bone fragility and increased risk for fractures. **Aim:** Assessment of risk factors responsible for falls in patients with reduced bone mineral density. **Material and Methods:** Using prospective cross-sectional study, from September to November 2015. in osteodenziotometric studio of Special Hospital for Rheumatic Diseases Novi Sad, 68 postmenopausal women aged 65 year an older were examined. Bone mineral density was measured by dual X-ray absorptiometry LUNAR device. They signed informed consent for participation in the study and were interviewed about risk factors (begining and duration of menopause, time when was diagnosed and length of treatman of osteoporosis, existance, number and localization fractures), were tested by Berg's balance scale, Timed Up and Go test and each on scale 0-100 assessed their health condition. Excluding factors: premenopausal women, bone mineral density in the reference values, other metabolic bone and musculosceletal diseases, hypotension, patients with low vision, cataract, Parkinson's disease, stroke, cognitive dissabilities, gait, balance and sensory impairment disorders, visual impairment and hearing that can´t be corrected. Statistical analysis were done in SPSS program ver. 20th. **Results:** Examinees aged 72.6±5.47 years, have high degree of risk for fall to TUG test and Berg's balance scale ($p<0.05$). Examinees that have a high risk for fall to the TUG test ($p<0.01$) and the Berg balance scale ($p<0.05$) have a lower quality of life. Examinees who have higher number of fractures have greater risk for fall to ($p<0.05$) and those with T-score at the level of osteoporosis ($p<0.01$). Worse quality of life is associated with number of vertebral fractures ($p<0.05$) and T-score at the level of osteoporosis ($p<0.01$). **Conclusion:** Older patients with a greater number of fractures, lower bone mineral density and poor quality of life have an increased risk of falling.

INTRODUCTION

A fall is defined as a sudden, unexpected change in position, when the static and mechanic mechanisms are unable to fulfill their function, and voluntary mechanisms and reflexes responsible for keeping up the balance are inadequate. Physiological definition of a fall would entail the possibility to hold an upright position under the outer and inner influences that cause imbalance. During such an unexpected event, person comes in contact with the ground, floor or a lower level.[1,2] Falls involving older population are a main health problem in the sense of morbidity, mortality and cost of health and social services, causing severe health issues, social isolation, injuries that provoke progressive invalidity, immobilization, comorbidity, addiction, hospitalization and death.[3-5] Severity of complications that are a consequence of a fall, show a rise with age. [1]

Frequency of falling rises exponential with age for the elderly and is higher in women than men.[4] Between 28% and 35% of people that are 65 or older, experience at least one fall per year, and the annual prevalence rises with age.[6] Reoccurring falls induce greater risk of fracture. Although most of the fractures follow falling, most of the falls do not

lead to fractures. This fact opens up an ideal opportunity for practitioners to identify patients that are in risk of fractures.(7)

Depletion in bone mineral density influences the fragility of the bones and causes greater risk for fractures.(8) Most of the fractures in elderly people are caused by falling from their own hight. These fractures are thus characteristic of smaller trauma and often affect the pelvic, wrist, upper-arm and hips. Faulty microarchitecture of the bones with low mineral bone density is indicative of a possible fracture, and combined with risk factors for potential falls, could indicate which persons are at higher risk of fractures (1).

Risk factors for falls can be biological (internal), behavioral, social and economical, as well as environmental factors. Risk of a fall is greater when there are more risk factors involved, and they are all increased with age. Having in mind that falls represent the main precursors of fractures, preventing a fall is a base for planning and efficient fracture prevention.

There is a number of tests for assessing a change in walking, balance, muscle strength, coordination and functionality. Most used balance and walking assessment tests are *Timed Up and Go Test (TUG test), Berg balance scale (BBS), as well as Get Up* and *Go Test and Performance-Oriented Mobility Assessment.* (1)

Aim

The aim of this research is the assessment of risk factors responsible for falls in patients with reduced bone mineral density.

Material and Methods

We have included 68 post-menopause women in our prospective study, all of which were patients of the osteodensitometry Cabinet of the Specialized hospital for rheumatic diseases in Novi Sad, from September 2015 to November 2015. Their number was deduced by a Sample size method, and the resulting value of the sample has a trust interval of 90% with a maximal error of 10%, and a critical incidence value of 50%. For these parameters the sample size of 68 women is sufficient and adequate.

The study includes post-menopause women that are 65 or older, that had their body weight and height measured in order to obtain the values for their Body Mass Indexes (BMI). All patients signed an informative consent for taking part in this study and were asked about risk factors - menopause age, how long the menopause lasted, when were they first diagnosed and how long have they been treated for osteoporosis, existence, number and location of fractures. Participants were tested using Bergs balance scale and Timed Up and Go - TUG test, and were asked to assess their general wellbeing at the moment of testing on a scale from 0 do 100. All participants had their bone mineral density measured in their hip and lumbar part of the back by double-energy X-ray absorptiometry with the LUNAR apparatus. Measured values are expressed in absolute units (g/cm^2), and are interpreted by T-scores according to a current definition of osteoporosis.

Exclusion factors include patients that are premenopausal, that have bone mineral density inside the reference range (T-score >-1SD), those diagnosed with other metabolical bone diseases or muscular-skeletal disease, hypotension, bad eyesight or cataract, Parkinson's disease, cognitive difficulties, stroke, walk impairment, damaged balance, sensor disorders, sight and hearing impairments that cannot be bettered, as well as patients that are on benzodiazepines, hypnotics or anti-arrhythmic medications.

Obtained results were analyzed statically, with the adequate choice of statistical methods in two phases. The first phase involved quantification of the results and categorization of patients according to the frequency of corresponding variables. The second phase involved the statistical analysis of the data. Obtained data was classified, and then separated into categories according to different characteristics.

Statistical processing and analysis were executed via computer program SPSS ver. 20 (Statistical Package for the Social Sciences), additionally, graphics and tables are processed using Microsoft Office tools (Excel and Word).

Results

Average age of examinees in our sample is 71.9±12.41 kg; average height is 158±5.72cm, accordingly their average Body Mass Index is (BMI) 28.8±4.9kg/m^2. (Table 1.)

Table 1. *Average age, weight, high and BMI of the patients*

	N	Min	Max	M	SD
Age	68	65.00	87.00	72.6471	5.47113
Weight (kg)	68	41.50	100.00	71.9926	12.41012
Height (cm)	68	142.00	171.00	158.0221	5.72793
BMI (kg/m2)	68	20.58	43.60	28.8273	4.90040

N-number of patients; Min.-Minimal value of the variable in our sample; Max.-Maximum value of the variable in our sample; M-Mean value of the variable in our sample, SD-standard deviation on the variable in the sample;

Majority of the patients had their BMI over the normal nutrition value, normal nutrition value is noted in 22.1% of the patients, whereas there were no underweight persons in our sample. (Table 2.)

Table 2. *Body Mass Index (BMI) of the patients*

	Frequency	Percentage(%)
Normal nutrition	15	22.1
Overweight	30	44.1
Obese	23	33.8
Total	68	100.0

Our examinees had their average menopause age of 47.5±4.66, and their menopause lasted 24.1±7.84 years for on average. (Table 3.)

Table 3*. Age of the beginning of menopause and menopause duration*

	N	Min	Max	M	SD
Age when the menopause started	68	35.00	55.00	47.5441	4.65988
Menopause duration	68	8.00	50.00	24.1029	7.84579

N-number of patients; Min.-Minimal value of the variable in our sample; Max.-Maximum value of the variable in our sample; M-Mean value of the variable in our sample, SD-standard deviation on the variable in the sample;

Less then 1/5 of our patients (17,6%) started their menopause early. (Table 4.)

Table 4. *Frequency of an early menopause (before 45 years of age)*

	Frequency	Percentage (%)
Yes	12	17.6
No	56	82.4
Total	68	100.0

Average values on all three segments were in line with the osteopenia diagnosis. (Table 5.)

Table 5. *Mean T-score values of the femur neck, hip and spine*

	N	Min	Max	M	SD
T-score of the femur neck	68	-3.90	-0.10	-1.7647	0.71608
T-score of the hip	68	-3.80	0.50	-1.3941	0.83306
T-score of the spine	68	-4.90	4.10	-1.5559	1.48609

N-number of patients; Min.-Minimal value of the variable in our sample; Max.-Maximum value of the variable in our sample; M-Mean value of the variable in our sample, SD-standard deviation on the variable in the sample;

According to the segment where the T-score was measured, most of the patients have their T-scores in line with osteopenia, while T-score in line with osteoporosis is seen mostly on the spinal area. From the total number of people in our sample, 64.7% had osteopenia on at least one of the area where we took the measurements, 29.4% osteoporosis and only 5.9% had normal results at at least one area where the measurements were made. (Table 6.)

Table 6. *Categories of the respondents according to T-score values at their places of measurement*

T-score of the femur neck	Frequency	Percentage (%)
Normal results	11	16.2
Osteopenia	49	72.1
Osteoporosis	8	11.8
Total	68	100.0
T-score of the hip		
Normal results	23	33.8
Osteopenia	40	58.8
Osteoporosis	5	7.4
Total	68	100.0
T-score of the spine		
Normal results	22	32.4
Osteopenia	33	48.5
Osteoporosis	13	19.1
Total	68	100.0
Group		
Normal results	4	5.9
Osteopenia	44	64.7
Osteoporosis	20	29.4
Total	68	100.0

In our group of 68 patients, 31 (45.6%) experienced some sort of a fractures, whereas only one of the patients had a hip fracture. (Table 7.)

Table *7. Fractures in our sample of patients*

Fractures	Frequency	Percentage (%)
Yes	31	45.6
No	37	54.4
Total	68	100.0
Hip fracture		
Yes	1	1.5
No	67	98.5
Total	68	100.0

The average number of vertebral fractures amongst our patients is 0.5±1.44, which is less then one fracture per person. The average number of non-vertebral fractures is also less then one per person (0.3±0.7), whereas the total number of fractures averages out to 0.85±1.54. (Table 8.)

Table 8. *Average number of vertebral, non-vertebral and total number of fractures*

	N	Min	Max	M	SD
No. of vertebral fractures	68	0.00	10.00	0.5147	1.44028
No. of non-vertebral fractures	68	0.00	4.00	0.3529	0.70742
Total number of fractures	68	0.00	10.00	0.8529	1.53822

N-number of patients; Min.-Minimal value of the variable in our sample; Max.-Maximum value of the variable in our sample; M-Mean value of the variable in our sample, SD-standard deviation on the variable in the sample;

Out of the total sample, 34 patients have an average time of osteoporosis treatment of 4±2.7 years, and they were diagnosed at the age of 68.8±6.1 on average. (Table 9.)

Table 9. *The average number of years of treatment of osteoporosis and the average age when it was diagnosed*

	N	Min	Max	M	SD
Average duration of osteoporosis treatment	34	1	9	4.00	2.730
Age when the diagnosis of osteoporosis was given	34	57.00	79.00	68.8529	6.19938

N-number of patients; Min.-Minimal value of the variable in our sample; Max.-Maximum value of the variable in our sample; M-Mean value of the variable in our sample, SD-standard deviation on the variable in the sample;

χ^2 test was used to determine a statistical correlation between the Berg balance scale and the TUG test (χ^2=5.53, df=1, p=0.019) and it has a statistical significance at the 0.05 level. According to our results, those patients that face low risk judging by their TUG test will have a medium fall risk on the Berg balance scale (62.1%), whereas those patients that have high fall risk according to the TUG test will have a high fall risk on the Berg balance scale as well (66.7%). (Table 10.)

Table 10. *Correlation of the TUG test and Berg balance scale*

			Berg balance scale		Total
			Medium fall risk	High fall risk	
TUG test	Low fall risk	Total	18	11	29
		%	62.1%	37.9%	100.0%
	High fall risk	Total	13	26	39
		%	33.3%	66.7%	100.0%
Total		Total	31	37	68
		%	45.6%	54.4%	100,0%

Statistically significant correlation of the Berg balance scale and self-reported quality of life can be seen in our results (F=4.43, p=0.039) at the 0.05 level. One can deduce that those patients that have medium fall risk report higher quality of life (66.5±14.3) compared to those facing higher fall risk (58.7±15.8). (Table 12.)

Statistically significant difference of self-reported quality of life and the TUG test (F=14.54, p=0.000), equals 0.01. It can be concluded that those patients that have lower fall risk have a higher quality of life (69.9±12.6) compared to those that have a greater fall risk (56.6±15.6). (Table 11.)

Table 11*. Correlation between the TUG test and the quality of patients life*

TUG test	M	SD	F	p
Low fall risk	69.9310	12.61216	14.542	0.000
High fall risk	56.6410	15.28585		
Total	62.3088	15.58344		

M-mean value of the variable in the sample; SD-standard deviation, (average deviation of singular values from the average value in the sample), F-ANOVA, p-statistical significance, Statistical significance at the 0.01 level

Table 12. *Correlation of the Berg balance scale and the quality of life in our patient sample*

Berg balance scale	M	SD	F	p
Medium fall risk	66.5484	14.34536	4.433	0.039
High fall risk	58.7568	15.87522		
Total	62.3088	15.58344		

M-mean value of the variable in the sample; SD-standard deviation, (average deviation of singular values from the average value in the sample), F-ANOVA, p-statistical significance, Statistical significance at the 0.05 level

Statistically significant difference between patients can be seen only for the total number of fractures variable (F=5.08, p=0.027), it is lower then 0.05 and at the level of statistical significance of p<0,05.

Mean value of total fracture number in patients with higher fall risk is 1.2±1.9. In patients that have lower fall risk, average number of total fractures is 0.37±0.56, which is much less then 1. (Table 13.)

Table 13. *Correlation of the TUG test and variables*

TUG test		*No. of vertebral fractures*	*No. of non-vertebral fractures*	*Total number of fractures*	*Total duration of treatment of osteoporosis*	*Age when the patient was diagnosed with osteoporosis*	*Menopause age*	*Menopause duration*
Low fall risk	M	0.1724	0.2069	0.3793	3.88	65.8750	48.0000	22.2069
	SD	0.38443	0.49130	0.56149	2.532	6.03413	4.97135	8.36822
High fall risk	M	0.7692	0.4615	1.2051	4.04	69.7692	47.2051	25.5128
	SD	1.84193	0.82226	1.90815	2.835	6.06833	4.44960	7.22158
Total	M	0.5147	0.3529	0.8529	4.00	68.8529	47.5441	24.1029
	SD	1.44028	0.70742	1.53822	2.730	6.19938	4.65988	7.84579
F		2.939	2.193	5.086	0.021	2.526	0.480	3.043
p		0.091	0,143	0.027	0.885	0.122	0.491	0.086

M-mean value of the variable in the sample; SD-standard deviation, (average deviation of singular values from the average value in the sample), F-ANOVA, p-statistical significance, Statistical significance at the 0.05 level

χ^2 tests shows a statistically significant correlation of the TUG test results and T-score (χ^2=12.60, df=2, p=0.002), and it equals 0.01.

Results show that osteopenia is frequent in both low and high fall risk groups. The difference rises from the fact that 43.6% of the patients with higher fall risk have osteoporosis at at least one place where measurements were made, whereas the low fall risk group shows only 10.3% of osteoporosis occurrence in our sample. (Table 14.)

Table 14. *Correlation of the TUG test and T-score values*

			Group			Total
			Normal results	Osteopenia	Osteoporosis	
TUG test	Low fall risk	Total	4	22	3	29
		%	13.8%	75.9%	10,3%	100.0%
	High fall risk	Total	0	22	17	39
		%	0.0%	56.4%	43.6%	100.0%
Total		Total	4	44	20	68
		%	5.9%	64.7%	29.4%	100.0%

There is no statistically significant difference between the Berg balance scale and variables of interest (p>0.05). (Table 15.)

Table 15. *Correlation of Berg balance scale and variables of interest*

Berg balance scale		*No. of vertebral fractures*	*No. of non-vertebral fractures*	*Total number of fractures*	*Total duration of treatment of osteoporosis*	*Age when the patient was diagnosed with osteoporosis*	*Menopause age*	*Menopause duration*
Medium fall risk	M	0.3871	0.3226	0.6774	3.15	69.6154	47.8710	22.8065
	SD	0.84370	0.59928	1.01282	2.544	6.39711	4.39501	6.51879
High fall risk	M	0.6216	0.3784	1.0000	4.52	68.3810	47.2703	25.1892
	SD	1.80048	0.79412	1.87083	2.768	6.18447	4.91397	8.74591
Total	M	0.5147	0.3529	0.8529	4.00	68.8529	47.5441	24.1029
	SD	1.44028	0.70742	1.53822	2.730	6.19938	4.65988	7.84579
F		0.444	0.104	0.739	2.088	0.312	0.277	1.569
p		0.508	0.749	0.393	0.158	0.581	0.600	0.215

M-mean value of the variable in the sample; SD-standard deviation, (average deviation of singular values from the average value in the sample), F-ANOVA, p-statistical significance, Statistical significance at the 0.05 level

χ^2 test concludes that there is no statistically significant correlation between the results of the Berg balance scale and T-score (χ^2=2.78, df=2, p=0.249), and it lays above the limit of 0.005. (Table 16.)

Table 16. *Correlation of the Berg balance scale and T-score results*

			Group			Total
			Normal results	Osteopenia	Osteoporosis	
Berg balance scale	Medium fall risk	Total	2	23	6	31
		%	6.5%	74.2%	19.4%	100.0%
	High fall risk	Total	2	21	14	37
		%	5.4%	56.8%	37.8%	100.0%
		Total	4	44	20	68
		%	5.9%	64.7%	29.4%	100.0%

Statistically significant correlation only exists between the values of self-reported quality of life and the number of vertebral fractures (r=-0.261, p=0.032). Correlation is negative and is statistically significant at the 0.05 level. Therefore, the more vertebral fractures one experiences the worse the quality of life will be, according to our patient sample. (Table 17.)

Table 17*. Correlation between the quality of life and variables of interest*

		Assessment of health status at the time of testing (0-100)
No. of vertebral fractures	r	-0.261*
	p	0.032
	N	68
No. of non-vertebral fractures	r	0.109
	p	0.376
	N	68
Total number of fractures	r	-0.202
	p	0.099
	N	68
Total duration of treatment of osteoporosis	r	0.026
	p	0.884
	N	34
Age when the patient was diagnosed with osteoporosis	r	-0.184
	p	0.297
	N	34
Menopause age	r	0.013
	p	0.913
	N	68
Menopause duration	r	-0.177
	p	0.150
	N	68

N-number of patients; r-Pearson correlation coefficient; p-statistical significance

Namely, one can conclude that the patients with the T-score values inside normal limits have the best quality of life (73.5±11.62), followed by those that have T-score levels that are a sign of osteopenia (68.1±12.1), whereas patients that have T-score values on the osteoporosis level have the worst quality of life (47.15±12.48). (Table 18.)

Table 18. *Correlation between the quality of life and T-score values*

	M	SD	F	p
Normal results	73.5000	11.61895	22.262	0.000
Osteopenia	68.1818	12.09511		
Osteoporosis	47.1500	12.48272		
Total	62.3088	15.58344		

M-mean value of the variable in the sample; SD-standard deviation, (average deviation of singular values from the average value in the sample), F-ANOVA, p-statistical significance, Statistical significance at the 0.01 level

Comparing the T-score values with the self-reported quality of life results, there is a statistically significant difference (22.26, p=0.000) and it is at the 0.01 level.

DISSCUSION

Falls influence an elderly person's life significantly, furthermore, due to their frequency they diminish multiple organ's functions. [9] Every year, one third of the population experiences a fall, and as much as 33% of elderly have their functionality diminished due to falling. [9,10]

Falls and injuries caused by falls are a main issue in post-menopausal women. Fear of fall, walk impairment and postural control, as well as changes in the body composition, have been identified as major risk factors. [11]

Our research was conducted on patients with an average age of72.6±5.47 and BMI over average values. Risk of a fall is higher in older people and is doubled every year after one turns 65. [12] In the study conducted by Pluskiewicz et al., in February 2015, that presented epidemiological data on falls in post-menopausal women, there were 978 women with average age of 65.78±7.63 and average BMI of 30.54±4.9, which is consistent with our data. Falls were not correlated with weight or height, but there was a significant correlation with the BMI (r=0.076, p<0.05). [13] Age is also a factor in diminishing the bone mineral density. [14]

The majority of our patients had their BMI over the normal values, normal value was measured for 22.1% persons and there were no underweight persons. Global population is getting more and more old and more overweight. Correlation between feeling weak and falling is something very present in the older population and is connected to poor health outcomes. Little is known of this correlation in people that are overweight. Study conducted by Sheehan et al. (2012) measured the relation between BMI, falling and general weakness, and concluded that people with higher BMI have a lower probability of falling. [15]

In our sample, menopause age averaged on 47.5±4.66 years, and had an average duration of 24.1±7.84 years. In women that are post-menopausal, their age, year when they started menopause, smoking and positive family history of fractures, are all clinical indicators of osteoporosis, and hormone treatment, as well as high BMI values have proved to be a protective factors. [16] In the study by Zvekić-Svorcan et al. (2013) 130 postmenopausal women were included, with an average age of 63.92±8.12 years, and average menopausal age of 48.69±4.86 years, average menopause duration at the time of BMD evaluation was 15.12±7.93 years. Authors concluded that menopause is an important risk factor that lowers bone mineral density, therefore it is important to refer all post-menopausal women to have osteodensitometric measurements of their bone mineral density to have a timely diagnosis and therapy in order to prevent osteoporotic fractures. [17]

Less then 1/5 of the examinees (17.6%) experienced early menopause in our sample. In a retrospective study

(2003-2007), conducted by TöRöK-Oance (2013), 177 patients that were post-menopausal and had an osteoporosis diagnosis, showed most frequent risk factor to be early menopause, in more then 44.63% women in the sample. [18] Early menopausal age is considered to be between 40 and 45 years. [19]

Average T-score values on all three segments were on an osteopenia level in our sample. Measurements of Bone mineral density - BMD, by dual-energy X-ray absorptiometry - DXA, is thought to be a gold standard for osteoporosis diagnosis. [14] Osteoporosis is the most common metabolic bone disease, and early detection of lowering in bone density is the first step in prevention, treatment and rehabilitation in osteoporosis patients. [20]

According to the T-score measurements, most of our patients had their T-score in line with osteopenia, whereas T-score in line with osteoporosis is most common on patient's spine in our sample. From the total number of examinees, 64.7% had osteopenia on at least one place of measurement, 29.4% had osteoporosis and only 5.9% had normal results on at least one place of T-score measurement.

By the World Health Organization - WHO guidelines, osteoporosis is defined by T-score that is expressed in standard deviations (SD): normal results are obtained when the T-score is above -1SD, osteopenia corresponds to values between -1SD to >-2.5SD, and osteoporosis is indicated by values ≤-2,5SD, whereas existence of minor trauma fractures indicates severe osteoporosis with fracture complications. [14,21] Diminished bone mineral density is the best indicator of fracture risk for the region where it is measured, having in mind that the loss of bone mass is asymptotical until an osteoporotic fracture occurs. [22]

In our sample of 68 women, 31 (45.6%) experienced a fracture, but only one of the examinees had a broken hip incident. Osteoporosis causes more then 8.9 million fractures per year worldwide, which translates to one fracture in every 3 seconds. [22] Hip fractures are the most severe osteoporosis repercussion, because such fractures demand obligatory hospitalization and are correlated with high mortality and morbidity values: 80% of hip fractures are found in women, and 90% in persons older then 60 years. [23]

Average number of vertebral fractures is 0.5±1.44 amongst our examinees, which translated to less then one fracture per person. Non-vertebral fractures are less then one per person on average (0.3±0.7), whereas total number of fractures equals 0.85±1.54. Cross-sectional study (Lambrinoudaki, 2015) had a goal to test the frequency of asymptomatic vertebral fractures (AVF) and potential risk factors in post-menopausal women. In this study there were 454 women aging between 35 and 80 years, and 8.15% of them had at least one vertebral fracture, osteoporosis on the lumbar spinal area and neck of the femur had a 23.1% of incidence. Prevalence of AVF is highly correlated with age. [24] From our total sample, 34 examinees have been treated for osteoporosis for 4±2.7 on average, and have been diagnosed when they were 68.8±6.1 years old, on average. Study conducted by Aguilar et al. (2015) included 746 examinees (69% were women), where 18% were diagnosed with osteoporosis, and 30% underwent pharmacological treatment. More than half of the examinees had high fall risk, and their daily activities were limited regardless of the diagnosis of osteoporosis. [25]

Statistically significant correlation between the Berg balance scale and the TUG test is at the level of $p<0.05$ in our study.Namely, majority those respondents who have a low risk of fall in the TUG test, will have a medium level of risk of falling according to Berg balance scale (62.1%), while those with a high risk of falling on the TUG test will have a high fall risk on Berg balance scale (66.7%). In a research conducted on a group of 45 women from Brazil, the balance was evaluated by the TUG test and Berg balance scale (BBS). The purpose of this study was to assess the situation and functional mobility in women with and without osteoporosis and check if the history of falls is associated with values on the TUG test and BBS, since both are used a lot in clinical practice. The results showed that the history of the falls is not in correlation with the TUG and BBS, BBS and TUG showed differences in the results in a group of young women with normal BMD, compared with the other two groups of older women with and without osteoporosis. The TUG test showed no difference between elderly persons with and without osteoporosis. The study concluded that the reference value for the TUG and BBS are not suitable for testing for women from Brazil. [26]

Statistically significant difference of quality of life and self-perceived TUG test is at the level of 0.01.Women who have a low risk of falling have a higher level of quality of life (69.9±12.6) compared to those who have a high fall risk (56.6±15.6).

Measuring the walking speed and the TUG test can be used to determine the quality of life and social participation of older people who have suffered vertebral fractures caused by osteoporosis, lower extremities, pelvis and ankle joint. Improving the value of the tests one may affect the social participation of men, reducing the risk of social isolation, contributing to a healthier lifestyle, and therefore inducing better quality of life. [27]

Statistically significant difference between the Berg balance scale and self-reported quality of life exists ($p<0.05$). Subjects with medium fall risk have a higher level of quality of life (66.5±14.3) compared to those who have a high risk of falling (58.7±15.8). Berg balance scale is one of most commonly used scale with a multi-factor evaluation process, used to assess balance and risk of falling in the elderly. [28] In a study conducted by Ozcan et al. (2005) the objective was to investigate the relation between quality of life and risk factors for falling in the elderly. In a group of 116 respondents, aged over 65 years, balance, as a risk factor falling, was evaluated using BBS. Positive correlation was found between quality of life and the value of BBS, just as the results of our study have shown. [29]

Looking at the correlation between the TUG test and variables, statistical significance ($p<0.05$), is present when looking at the total number of fractures. Subjects with a high fall risk had higher number of fractures compared to the group of respondents with a low risk for a fall. The two main risk factors related to the skeletal fractures in the elderly are: reduced BMD and the risk of falling. A study conducted by

Zhu et al (2011) included 1,126 women, and nearly a third had TUG test value greater than 10.2 seconds, and 54.2% of them had low hip BMD (T-score<-1). In comparison to the risk factors among the respondents, non-vertebral fractures and hip fractures were significantly higher in patients with high TUG test values, as well aw normal and reduced BMD values. (30)

Statistically significant correlation was found between the results of the TUG test and T-score and it is at the level of p<0.01. Osteopenia is the most common in the group of low and high fall risk results. However, the difference lies in the fact that 43.6% of those with a high risk of falling have been diagnosed with osteoporosis on at least one area of measurements, while in the low-risk group, only 10.3% had osteoporosis. The study conducted by Abreu et al. (2010) had the aim of answering the question, whether women with low bone mineral density have greater postural instability. The results obtained in this study are confirmed in our research. A group of women with osteoporosis had poorer balance than those in the group of women with normal bone mineral density. (31)

Assessing at the values of Berg balance scale and variables, we found no statistically significant difference (p> 0.05). Our results showed no statistically significant correlation between the Berg balance scale (BBS) and the number of fractures, but in a prospective study of 298 subjects the risk of fall was evaluated relative to the value of 9 items of BBS. During the 12-month follow-up there were 271 falls in total, and 29 required treatment. In the next 36 months as much as 98 falls required treatment. Number of falls was higher in the group of subjects with poorer values of BBS (158 respondents) than in the group of subjects with better values on the BBS (140 respondents). (32)

Our results show that there is no statistically significant correlation between the scores on Berg' balance scale with the values of T-score (p>0.05). Paper by Miko et al. (2016) included 100 women who were diagnosed with osteoporosis, aged above 65 years with at least one fracture, balance was estimated by Berg balance scale and the TUG test. After a twelve-month balance exercise program, the patients significantly improved their parameters of balance, reduced the number of falls in post-menopausal subjects who had at least one fracture in the past. (33)

Comparing the value of quality life with variables, there is a statistically significant correlation with the number of vertebral fractures and they are negatively correlated with the quality of life. Larger number of vertebral fractures indicating poorer quality of life among our respondents. Vertebral fracture was the most common fracture due to osteoporosis, which affects the quality of life and increased mortality in the population. (34) The impact of osteoporotic vertebral fractures on quality of life is often underestimated. (35) Back pain is one of the main symptoms in elderly patients with osteoporosis. Pain control is important because the pain interferes with the quality of life. (36)

Statistically significant difference exists between the value of T-score and quality of life in our respondents.The worst quality of life is found in subjects whose T-score values are at the level of osteoporosis, followed by those with a T-score at the level of osteopenia, while those with values of T-score in the normal range have the best quality of life. Osteoporosis is characterized by chronic pain, loss of height, deformation, disability and impaired quality of life, and it manifests itself in great difficulty and pain, difficulty in movement and hospitalization. (37)

CONCLUSION

• Patients with their T-scored in line with osteoporosis diagnosis have a worse quality of life and high risk of falling.

• Lower life quality and high risk of falling is apparent in patients that underwent TUG tests and were assessed by the Berg balance scale.

• Patients with a higher number of fractures face higher risk of falling, and worse quality of life is visible in patients with multiple vertebral fractures.

Sažetak

Uvod: Smanjenje mineralne koštane gustine ima za posledicu krhkost kostiju i povećan rizik za nastanak preloma. **Cilj:**Procena riziko faktora odgovornih za pad kod pacijentkinja sa sniženom mineralnom koštanom gustinom. **Materijal i metode:** Prospektivnom studijom preseka, od septembra do novembra 2015. godine u osteodendizometrijskom kabinetu Specijalne bolnice za reumatske bolesti Novi Sad, pregledane su 68 postmenupauzalne žene starosne dobi 65 godina i starije. Mineralna koštana gustina merena je dvostrukom X-zračnom apsorpciometrijom LUNAR aparata. Ispitanice su potpisale informisani pristanak o učešću u studiji i anketirane su o faktorima rizika (godina ulaska i dužina trajanja menopauze, kada je prvi put postavljena dijagnoza i ukupna dužina lečenja osteoporoze, postojanje, broj i lokalizacija preloma), testirane su Bergovom skalom balansa, Timed Up and Go testom (TUG test), na skali 0-100 svaka je procenila svoje zdravstveno stanje. Faktori isključenja: ispitanice u premenopauzi, mineralna košana gustina u referentnim vrednostima, prisustvo drugih metaboličkih bolesti kostiju, muskuloskeletnih bolesti, hipotenzija, ispitanice sa slabim vidom, kataraktom, Parkinsonovom bolesti, kognitivnim smetnjama, šlogom, poremećajima hoda, oštećenjem balansa i senzornim poremećajima, poremećajima vida i sluha koji ne mogu da se koriguju. Statistička analiza podataka rađena je u programu SPSS ver. 20. **Rezultati:** Ispitanice prosečne starosne dobi 72,6±5,47 godina, imaju visok stepen rizika za pad na TUG testu i Bergovoj skali balansa ($p<0,05$). Niži kvalitet života imaju ispitanice sa visokim rizikom za pad na TUG testu ($p<0,01$) i Bergovom skalom Balansa ($p<0,05$). Ispitanice pad ($p<0,05$)kao i one sa T-skorom na nivou osteoporoze ($p<0,01$). Lošiji kvalitet života je povezan sa većim brojem vertebralnih preloma ($p<0,05$) i T-skorom na nivou osteoporoze ($p<0,01$). **Zaključak:** Povećan rizik za pad imaju ispitanice starije životne dobi sa većim brojem preloma, nižom mineralnom koštanom gustinom i lošijim kvalitetom života.

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■ The paper was received on 04.05.2016. / Accepted on 12.05.2016.