ASSESSMENT OF THE FRACTURE RISK THROUGH FRACTURE RISK ASSESSMENT TOOL (FRAX) IN POSTMENOPAUSAL WOMEN

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Abstract. Current National Osteoporosis Foundation (NOF) guidelines recommend treating patients with a 10-year fracture risk (FRAX) of $\geq 3\%$ for hip fractures or $\geq 20\%$ for major osteoporotic fractures to reduce the future fracture risk. The present study investigated the distribution of the women in the groups with a FRAX score for major osteoporotic fractures below 20% and for hip fractures below 3%, as well as a FRAX score for major osteoporotic fractures $\geq 20\%$ and for hip fractures $\geq 3\%$. We found that women with a fracture risk corresponding to a FRAX score for major osteoporotic fractures $\geq 20\%$ and with a FRAX score for hip fractures $\geq 3\%$ were significantly older ($p = 0.000$) and had significantly lower weight and height ($p = 0.000$) compared to women with FRAX score for major osteoporotic fractures below 20% and with a FRAX score for hip fractures below 3%. Regarding the risk factors studied, women with a history of rheumatoid arthritis who currently use corticosteroids have the highest risk of fractures with a FRAX score for major osteoporotic fractures $\geq 20\%$ and a FRAX score for hip fractures $\geq 3\%$.

Key words: FRAX, fracture risk, women, menopause

INTRODUCTION

Osteoporosis is a metabolic bone disease characterized by low bone mass and deterioration of bone microarchitectonics, leading to increased fracture risk. Osteoporotic fractures are one of the causes of disability and mortality in the elderly population. While postmenopausal osteoporosis occurs due to low estrogen levels, the cause of senile osteoporosis is low levels of vitamin D3 [1, 2]. Bone mass alone cannot explain the risk of fractures in all cases [3]. The existence of patients with osteoporosis but without fractures and those with osteopenia but with multiple fractures proves that bone mineral density (BMD) alone is not a sufficient indicator for predicting fracture risk. It is estimated that women with scoliosis have higher fracture risk [4]. Using algorithms of computer vision we can easier detect patients with scoliosis and can better make decision about their fracture risk [5, 6, 7].

Globally, there are several tools for fracture risk assessment [8, 9]. The most popular is the Fracture Risk Assessment Tool (FRAX), which is available for free online. The FRAX algorithm is a web-based tool (www.shef.ac.uk/FRAX), published in 2008 by the University of Sheffield and developed to calculate the 10-year probability for major osteoporotic fracture (MOF) and for hip fracture (HF) based on clinical risk factors and BMD. According to the National Osteoporosis Foundation, treatment is recommend-

ed for patients with BMD of the lumbar spine, femoral neck or total hip corresponding to osteoporosis. For patients with osteopenia (with T-score between -1.0 SD and -2.5 SD), treatment is recommended for all ages and genders with FRAX MOF $\geq 20\%$ and with FRAX HF $\geq 3\%$ [10, 11, 12, 13].

The aim of this study is to evaluate the characteristics of patients with FRAX MOF $\geq 20\%$ and with FRAX HF $\geq 3\%$ using the innovative REMS technology.

PATIENTS AND METHODS

101 postmenopausal women aged 65 years $\pm$ 11 years (SD), (range 43-87) were included in the study. Women were divided into 2 groups according to the fracture risk: 1st – with FRAX MOF below 20% and FRAX HF below 3%, and 2nd - with FRAX MOF $\geq 20\%$ and FRAX HF $\geq 3\%$. FRAX score has been calculated without inclusion of the value of bone mineral density. Information is collected for the following risk factors – previous fractures, diagnosed rheumatoid arthritis (RA), smoking, use of glucocorticoids (GC) and alcohol consumption of more than 30 ml alcohol daily.

STATISTICAL ANALYSIS

A chi-square test was used to assess whether there is a significant difference between risk factors in the two groups. A descriptive statistical analysis

was used to describe the characteristics of both groups. Student's T-test for independent samples was used to assess the association between a quantitative and qualitative variable, and the chi-square test for two qualitative variables.

RESULTS

65.4% of the women (66/101 women) have FRAX score for MOF below 20% and 34.6% have FRAX score for MOF $\geq$ 20%. 48.5% (49/101) of the women have FRAX score for hip fractures (HF) below 3% and 51.5% have FRAX score for HF $\geq$ 3%. Women with FRAX MOF $\geq$ 20% and FRAX HF $\geq$ 3% were significantly older (mean age 73 years, respectively 72 years) than those with FRAX MOF below 20% and FRAX HF $<$ 3% (mean age 62 years, respectively 59 years), ($p = 0.000$). The mean weight and height of the women with FRAX MOF $\geq$ 20% and with FRAX HF $\geq$ 3% were significantly lower (mean weight 60.6 kg for FRAX MOF $\geq$ 20%, respectively 61.39 kg. for FRAX HF $\geq$ 3%, and mean height 151.7 cm for FRAX MOF $\geq$ 20% and 153.2 cm for FRAX HF $\geq$ 3%) of those women with FRAX MOF below 20% and FRAX HF $<$ 3% (mean weight 69.4 kg, 71.7 kg, mean height 158.75 cm and 159.67 cm, respectively), ($p = 0.003$ for the weight and $p = 0.000$ for the height), ($p = 0.000$), (Table 1).

Comparing risk factors: previous fractures, smoking, use of corticosteroids (CS), rheumatoid arthritis (RA) and alcohol consumption of more than 30

ml. alcohol daily in the groups formed according to the fracture risk, we established a statistically significant relationship for the risk factors: previous fractures, use of CS and history of RA. The ratio (women with previous fractures) / (women without previous fractures) is significantly higher in the groups with FRAX score for MOF $\geq$ 20% (3.25) and with FRAX score for HF $\geq$ 3% (1.55) compared to the groups with FRAX MOF $<$ 20% (0.40) and FRAX HF $<$ 3% (0.4), $p = 0.000$, comparing women with fractures between the groups according to FRAX MOF and $p = 0.001$, comparing the women with fractures between the groups according to FRAX HF. There is no statistically significant difference in the number of smokers and non-smokers, as well as in the number of women who consume more than 30 ml. alcohol per day compared to those who don't consume any alcohol or consume smaller amounts of alcohol daily between the groups according to FRAX MOF ($p = 0.342$) and according to FRAX HF (0.953). Corticosteroid use and diagnosis of RA are significant risk factors for FRAX MOF $\geq$ 20 ($p = 0.010$ and $p = 0.017$, respectively) and for FRAX HF $\geq$ 3%, ($p = 0.044$ and $p = 0.026$, respectively). The ratios (women using CS) / (women without CS) and (women with RA) / (women without RA) were significantly higher in the groups with MOF $\geq$ 20% (0.36 for CS and 0.62 for RA) and with FRAX HF $\geq$ 3% (0.24 for CS and 0.5 for RA) compared to the groups FRAX MOF $<$ 20% (0.08 for CS and 0.2 for RA) and FRAX HF $<$ 3% (0.09 for CS and 0.16 for RA), (Table 2).

Table 1. Student's t-test for independent samples to compare age, weight, height and BMI between the two groups; FRAX risk groups: MOF-major osteoporotic fracture, HF-hip fracture

		FRAX	N	Mean value	Standard deviation	p-value
FRAX MOF	Age (years)	$< 20\%$	66	62	8.918	0.000
		$\geq 20\%$	35	73	8.161	
	Weight(kg)	$< 20\%$	66	69.41	14.788	0.003
		$\geq 20\%$	35	60.68	10.221	
	Height (cm)	$< 20\%$	66	158.75	7.7946	0.000
		$\geq 20\%$	35	151.694	6.0236	
FRAX HF	BMDFN (g/cm ²)	$< 3\%$	49	59	7.464	0.000
		$\geq 3\%$	52	72	7.860	
	Age (years)	$< 3\%$	49	71.69	15.330	0.00
		$\geq 3\%$	52	61.39	10.431	
	Weight(kg)	$< 3\%$	49	159.67	7.9199	0.00
		$\geq 3\%$	52	153.16	6.6217	
FRAX HF	Height (cm)	$< 20\%$	66	62	8.918	0.000
		$\geq 20\%$	35	73	8.161	
	BMDFN (g/cm ²)	$< 20\%$	66	69.41	14.788	0.003
		$\geq 20\%$	35	60.68	10.221	

Table 2. Chi-square test for the significance of the risk factors in both groups

Risk factors		FRAX MOF		p-value	FRAX HF		p-value
		< 20%	≥ 20%		< 3%	≥ 3%	
		Count	Count		Count	Count	
Previous fractures	yes	36	32	0.000	28	40	0.001
	no	111	10		90	31	
Smoking	yes	38	5	0.342	32	11	0.110
	no	109	37		86	60	
Use of corticosteroids	yes	17	14	0.010	13	18	0.044
	no	130	28		105	53	
Rheumatoid arthritis	yes	34	19	0.017	26	27	0.026
	no	113	23		92	44	
Alcohol consumption more than 30 ml daily	yes	12	2	0.575	10	4	0.953
	no	135	40		108	67	

DISCUSSION

The need for adequate treatment of patients at high risk of fractures brings to the fore the need for new models to predict this risk. The FRAX algorithm, launched by the WHO in 2008, is a fracture risk assessment tool that gives a 10-year probability of major osteoporotic fractures and hip fractures [14, 15]. The clinical risk factors included in the FRAX model are, on the one hand, easily accessible and, on the other hand, strictly validated by evidence-based medicine [16]. In the present study, the ability to assess 10-year fracture risk with REMS technology, which has integrated FRAX software [17], motivates us to describe the characteristics of patients in different risk groups according to FRAX, using this innovative method.

The results of the study show that age is an important risk factor for MOF and HF and that there is a statistically significant difference in age between the groups. The effect of the age on risk assessment with FRAX is consistent with data provided by the National Osteoporosis Group [18]. In a study by Gadani et al., age was the only risk factor in postmenopausal women which differed significantly between identical and non-identical predictions [19, 20, 21, 22].

Weight and height were significant risk factors for FRAX MOF $\geq 20\%$ and for FRAX HF $\geq 3\%$ in the study. Similar results have been observed in other studies [23, 24, 25].

Although low BMD values are crucial for osteoporotic fractures, some fracture cases are characterized by BMD that is not in the range of osteoporosis [26, 27]. According to Kanis et al., the prediction of fractures only through clinical risk factors and without the inclusion of BMD in the FRAX algorithm is comparable to that with the inclusion of BMD. In the

present study, patients with lower BMD showed a significantly higher FRAX score for MOF and HF, which is in agreement with other studies [28].

According to our study, the presence of previous fractures is significant for FRAX MOF $\geq 20\%$ and for FRAX HF $\geq 3\%$. In the study of Morin et al., nontraumatic fractures in women were associated with osteoporosis of the femoral neck, and the authors showed that the location of previous fractures affected future fracture risks, regardless of BMD values [28].

Rheumatoid arthritis is included as a dichotomous predictor in the WHO FRAX algorithm for predicting the 10-year risk of hip or major osteoporotic fractures. In our study, RA was a significant factor for FRAX MOF and FRAX HF. Several studies have shown, in agreement with our study, that the incidence of fractures is higher in patients with RA [29,30].

The use of corticosteroids (CS) is also used in the FRAX model. They affect fracture risk regardless of bone density. According to Kanis et al., the use of these drugs is a significant factor for fracture probability. Fracture probabilities increase by 15% for high doses of CS (> 7.5 mg daily) [29,30].

CONCLUSION

Adult postmenopausal women with low BMD, low weight and height, previous fractures, rheumatoid arthritis and corticosteroids have the highest risk of fractures with FRAX MOF $\geq 20\%$ and FRAX HF $\geq 3\%$.

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Постъпила за печат: 13.11.2021 г.

Submitted: 13.10.2021

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