ORIGINAL PAPER

Submitted: 01.10.2024
Accepted: 01.11.2024
Early publication date: 14.02.2025

Endokrynologia Polska
DOI: 10.5603/ep.102879
ISSN 0423–104X, e-ISSN 2299–8306

Assessment of fracture risk based on FRAX score and Polish guidelines in patients with newly diagnosed osteoporosis

Wioletta Stępień-Kłos[1], Marta Michalska-Kasiczak[1], Katarzyna Płoszka[2], Michał Stuss[1], Ewa Sewerynek[1]

[1]*Department of Endocrine Disorders and Bone Metabolism, Chair of Endocrinology, Medical University of Lodz, Lodz, Poland*
[2]*Department of Biostatistics and Translational Medicine, Medical University of Lodz, Lodz, Poland*

Abstract

Introduction: The authors of the latest recommendations state that osteoporosis diagnosis should not rely solely on densitometric (DXA) criteria. Fracture risk assessment is crucial for determining diagnosis and intervention thresholds. Comprehensive assessment of fracture risk requires consideration of bone mineral density (BMD) results, use of risk calculators like Fracture Risk Assessment Tool (FRAX™), and analysis of clinical and lifestyle factors. Experts highlight the need to identify patients at very high fracture risk to justify starting anabolic therapy. This retrospective study assessed fracture risk in newly diagnosed osteoporosis patients, identifying those at high and very high risk.

Material and methods: The study included 159 postmenopausal women with newly diagnosed osteoporosis, identified by a T-score of ≤ –2.5 standard deviations (SD) from DXA scans of the femoral neck and/or lumbar spine. Demographic data and laboratory tests were collected, and the 10-year fracture risk for major osteoporotic fractures (FRAX MOF) and hip fractures (FRAX HF) was calculated using the FRAX-PL calculator, which included femoral neck BMD. Each patient was then classified into a risk group based on modified fracture risk assessment criteria.

Results: The study found that the most common risk factor for osteoporosis was a previous fracture (56.6%). Other common risk factors included smoking (21.38%), parental hip fracture (13.21%), and glucocorticoid use (10.70%). The FRAX calculator showed that 47.80% of patients were at very high risk for HF and 23.90% for MOF. A high HF risk was present in 10.06% of patients, and high MOF risk in 34.59%, whereas a medium and low MOF risk concerned 25.79% and 15.72% of the subjects, respectively. With expanded criteria, 72.33% of patients were classified at very high risk, compared to 23.90% for MOF and 47.80% for HF based solely on FRAX. Most patients met the T-score ≤ –3.0 SD criterion (52.20%) and FRAX > 15% for MOF or FRAX > 4.5% for HF (52.20%). Women aged 65–70 and 70–75 yers are at the highest risk and qualify for anabolic therapy.

Conclusions: Our study highlights the importance of stratifying patients by fracture risk, showing that more individuals are identified at very high risk when using the expanded assessment criteria from the latest Polish guidelines.

Key words: *fracture risk; FRAX; very high risk for fractures; guidelines; osteoporosis*

Introduction

Osteoporosis is a major public health problem, particularly in aging populations. It leads to fractures, reduced mobility, and a lower quality of life. According to the data published by a group of experts from the International Osteoporosis Foundation (IOF) [1], in 2019, there were 1,985,000 individuals with osteoporosis in Poland, 80% of whom were women [2]. The 2023 estimates of the National Health Fund (NHF) [3], based on epidemiological indicators, indicate 2,120,000 cases, of which 1.7 million are women. Both reports show that the percentage of individuals receiving proper pharmacological treatment is very low — around 6% of all patients according to the NHF report and 17% of women who qualify for treatment according to the IOF data. Various statistics demonstrate that there are 126,000-206,000 osteoporotic fractures in Poland, while the mortality rate in the first year following a hip fracture is very high, reaching 30% [2], which is a significant clinical problem.

In 2023, the latest Polish recommendations for the diagnostic and therapeutic management of osteoporosis were published [4]. According to the authors, it is not sufficient to diagnose osteoporosis, both with and without fractures, based on densitometric criteria only. Fracture risk assessment should be regarded as the main determinant of diagnosis and intervention thresholds. There are several risk calculators available, the most popular of which is FRAX. However, in its current version, it does not include all risk factors for fractures, such as the number and location of fractures, the time elapsed since a fracture, the number of falls per year, and comorbidities. An extended version, FRAX Plus, has recently appeared on the market; however, due

Marta Michalska-Kasiczak; Department of Endocrine Disorders and Bone Metabolism, Chair of Endocrinology, Medical University of Lodz, Zeligowskiego 7/9 street, 90-752 Lodz, Poland, phone: +48501154853, e-mail: marta.zofia.michalska@umed.lodz.pl

to fee-based subscription, access to the tool is limited. Additionally, experts do not yet recommend its widespread use in the Polish population [5]. Nevertheless, because the issue is very important, Polish experts have proposed modified criteria for fracture risk assessment for men and women aged over 50 years, which include other risk factors, apart from the FRAX score.

It is now considered that the degree of fracture risk should determine the choice of treatment, particularly application of the most effective anabolic drugs in patients at a very high fracture risk. According to the latest guidelines, individuals at very high risk for fractures include those who meet at least one of the following criteria: recent low-energy major osteoporotic fracture within less than one year in a patient with a T-score ≤ –1.0 SD, multiple major osteoporotic fractures (≥ 2), a fracture occurring during glucocorticoid therapy, a low T-Score < –3.0 SD, and FRAX > 15% for major osteoporotic fractures or > 4.5% for hip fracture.

According to the proposed algorithm, drug treatment should be given to all individuals of both sexes aged over 50 years with low-energy fractures, as well as those at a very high, high, or medium risk for fractures. If a low-energy fracture occurs, pharmacotherapy should be implemented as soon as possible to reduce the risk of subsequent fractures. Currently, both European and American experts [6, 7] emphasise a special need to identify a group of patients at a very high risk for fractures, recognising a well-grounded indication for introducing anabolic therapy (teriparatide, abaloparatide, romosozumab) first, followed by sequential administration of antiresorptive medications. There is strong evidence confirming measurable benefits from the use of anabolic drugs in patients at a very high risk for fractures [8–10].

In our study, we focused on assessing the risk of fractures in patients with newly diagnosed osteoporosis and determining the percentage of subjects at a high and very high risk for fractures.

Material and methods

This retrospective study included 159 postmenopausal women with newly diagnosed osteoporosis between January and October 2023, who were patients of the Osteoporosis Clinic of the Medical Centre of the Holy Family Hospital in Lodz and the Independent Public Healthcare Unit at the Central Teaching Hospital of the Medical University of Lodz. The present study was conducted by reviewing an electronic medical record database. All patients who met the following eligibility criteria were included in the study: 1) female patients at least 2 years post-menopause with primary osteoporosis diagnosed no later than 6 months prior; and 2) patients who had never been treated for osteoporosis. Osteoporosis was diagnosed based on DXA results of the femoral neck and/or the lumbar spine T-score ≤ –2.5 SD. Premenopausal women, individuals with diagnosed secondary osteoporosis or active neoplastic disease, as well as patients previously treated for osteoporosis (except those taking calcium and vitamin D3) were excluded from the study. Demographic data collected from the patients included age, body mass index (BMI), comorbidities [arterial hypertension, diabetes mellitus (DM), ischaemic heart disease (IHD), asthma/chronic obstructive pulmonary disease (COPD), rheumatic diseases], history of fractures, use of glucocorticoids (GC), lifestyle habits (including alcohol consumption and smoking), and history of parental hip fractures. All the patients underwent a bone mineral density test using dual-energy X-ray absorptiometry (DXA) scanning with the Lunar iDXA (GE Healthcare, UK), and laboratory tests: 25(OH)D total, parathyroid hormone (PTH), creatinine/glomerular filtration rate (GFR), serum calcium and phosphorus levels, and alkaline phosphatase (ALP) level. Based on the FRAX calculator for the Polish population (FRAXPL) [11] (https://frax.shef.ac.uk/FRAX/tool.aspx?lang=po), including BMD, the absolute 10-year risk for major osteoporotic fracture (FRAX MOF) and hip fracture (FRAX HF) were calculated. A patient was classified into the very high fracture risk group if at least one of the following criteria was met: (1) occurrence of ≥ 2 major osteoporotic fractures (vertebrae, hip, distal radius, proximal humerus, pelvis); (2) T-score ≤ –3.0 SD of the lumbar spine (L1–L4)/total hip/femoral neck; (3) FRAX > 15% for MOF or FRAX > 4.5% for HF. A patient was classified into the high fracture risk group if at least one of the following criteria was met: (1) T-score ≤ –2.5 SD of the lumbar spine (L1–L4)/total hip/femoral neck; (2) FRAX 10-15% for MOF or FRAX 3–4.5% for HF. A postmenopausal patient (aged > 50 years) with no history of fractures and T-score > –2.5 SD was classified into the medium-risk group with FRAX 5 – < 10% and the low-risk group with FRAX < 5%. Statistical analysis was performed using Statistica software version 13.1 (TIBCO Software 2022). Continuous variables with a distribution different from normal were described using the median along with the 25th and 75th quartiles (Q1–Q3). The distribution for continuous variables was checked using the Shapiro-Wilk W test. Nominal variables were described using counts and percentages. The nonparametric Mann-Whitney U test was used to assess differences between the 2 groups for continuous variables with a distribution different from normal. Statistical significance was assessed at $p < 0.05$.

Results

The characteristics of the population are presented in Table 1. The median (Q1–Q3) of the age of the patients included in the study was 69 years, the median FRAX MOF was 11 (Q1–Q3: 6.4–15.0), and the median FRAX HF was 4.4 (Q1–Q3: 1.8–6.6). The prevalence of fracture risk factors and comorbidities are presented in Table 2. Among the risk factors, the highest percentage rate was smoking (21.38%), followed by parental hip fracture (13.21%) and taking glucocorticoids (10.70%). The total number of individuals with at least one fracture in adulthood in the whole population was 90, which corresponds to 56.6%. The following fractures were observed: 7 (7.78%) hip fractures, 35 (38.89%) spinal fractures, 31 (34.44%) wrist fractures, 17 (18.89%) other osteoporotic fractures (proximal humerus fracture, rib fracture, pelvis fracture), and 31 (34.44%) other non-osteoporotic fractures (fracture of the calcaneus, fibula, tibia, sternum, ankle, phalanx of hand, metacarpal bone, foot, patella, proximal end of the radius) (Tab. 3).

Table 1. *General characteristics of the study population*

Variable (n = 159)	Median (Q1–Q3)	Minimum–Maximum
Age [y]	69.00 (65.00–74.00)	51.00–89.00
BMI	24.7 (22.00–26.90)	17.80–42.20
Laboratory parameters		
Vitamin D [ng/mL]	39.04 (29.00–50.13)	6.00–126.89
PTH [pg/mL]	47.9 (38.66–53.54)	4.10–120.1
Creatinine [mg/dL]	0.76 (0.68–0.85)	0.53–1.45
GFR [mL/min/1.73 m^2]	72,80 (63.8–84.28)	28.60–124.00
Serum calcium [mg/dL]	9.70 (9.40–9.90)	2.53–10.50
Serum phosphorus [mg/dL]	3.51 (3.29–3.72)	1.19–4.77
ALP [U/L]	69.8 (61.47–83.00)	36.00–143.00
DXA T-Score		
Femoral neck DXA T-Score	–2.5 (–2.9–(–2.00)	(–4.50)–(–0.7)
Total hip DXA T-Score	–2.2 (–2.6–(–1.7)	(–5.30)–2.50
Lumbar spine (L1–L4) DXA T-Score	–2.8 (–3.3–(–2.4)	(–4.70)–0.70
FRAX		
FRAX major osteoporotic fracture	11.0 (6.4–15.0)	2.70–37.00
FRAX hip fracture	4.4 (1.8–6.6)	0.20–29.00

BMI — body mass index; PTH — parathyroid hormone; GFR — glomerular filtration rate; ALP — alkaline phosphatase; DXA — dual-energy X-ray absorptiometry

Table 2. *Prevalence of main fracture risk factors and comorbidities*

Patients (n = 159)		N (%)
Risk factors		
Current smoking	Yes	34 (21.38%)
Consumption of three or more units of alcohol per day	Yes	0 (0.00%)
Glucocorticoids	Yes	17 (10.70%)
Parental hip fracture	Yes	21 (13.21%)
Comorbidities		
Asthma/COPD	Yes	33 (20.75%)
Rheumatic diseases	Yes	11 (6.92%)
Diabetes mellitus	Yes	17 (10.69%)
Arterial hypertension	Yes	67 (42.14%)
Ischaemic disease	Yes	20 (12.58%)

COPD — chronic obstructive pulmonary disease

Table 3. *Types of fractures in studied population*

Variable		n (%)
Previous fractures* (N = 159)	Yes	90 (56.60%)
	No	69 (43.40%)
Hip fracture (n = 90)	Yes	7 (7.78%)
Spine fracture (n = 90)	Yes	35 (38.89%)
Distal radial fracture (wrist) (n = 90)	Yes	31 (34.44%)
Other osteoporotic fractures (n = 90)	Yes	17 (18.89%)
Other non-osteoporotic fractures (n = 90)	Yes	31 (34.44%)

N — number of individuals included in the analysis; *The summary is the total number of patients who had any fractures. It does not take into account whether patients had one or more fractures of different types; n — number of individuals who sustained types of fractures in adulthood; includes patients who may have had several different fractures

Fracture risk assessment based on FRAX score

The fracture risk, using the FRAX calculator and including BMD of the femoral neck, showed that 47.80% of the patients were at a very high risk for hip fracture (HF FRAX > 4.5%), while 23.90% met the criteria of a very high risk for major osteoporotic fracture (MOF FRAX > 15%). High risk for HF was found in 10.06% of the patients and high risk for MOF in 34.59% of the subjects. The 10-year medium and low risk for MOF were 25.79% and 15.72%, respectively (Tab. 4).

Fracture risk analysis according to expanded criteria

Fracture risk according to the expanded criteria identified subjects at very high (72.33%) and high (25.16%) risk for fractures and showed a very low percentage of those at low risk (1.26%) (Tab. 5). More individuals (72.33%) were categorised as being at very high risk for fractures based on the expanded criteria than on FRAX score alone (47.80% for HF and 23.90% for MOF).

Table 4. *Fracture risk assessment based on FRAX PL*

Fracture risk		HF (n = 159)	MOF (n = 159)
Very high For MOF FRAX > 15% For HF FRAX > 4.5%	Yes	76 (47.80%)	38 (23.90%)
	No	83 (52.20%)	121 (76.10%)
High For MOF FRAX 10–15% For HF FRAX 3–4%	Yes	16 (10.06%)	55 (34.59%)
	No	143 (89.94%)	104 (65.41%)
Medium For MOF FRAX from 5% to < 10%	Yes	–	41 (25.79%)
	No	–	118 (74.21%)
Low For MOF FRAX < 5%	Yes	–	25 (15.72%)
	No	–	134 (84.28%)

Table 5. *Fracture risk analysis according to expanded criteria*

Fracture risk (n = 159)		N (%)
Very high fracture risk	Yes	115 (72.33%)
	No	44 (27.67%)
High fracture risk	Yes	40 (25.16%)
	No	119 (74.84%)
Medium fracture risk	No	0.00 (0.00%)
Low fracture risk	Yes	2 (1.26%)
	No	157 (98.74%)

Assessment of the patients in terms of fulfilment of criteria for classification into the group of very high fracture risk and comparison with FRAX score

When adopting the expanded criteria for fracture risk assessment, it was shown that 72.33% of the patients participating in the study met at least one of the 3 criteria for a very high fracture risk. Among these subjects, the largest percentage (52.20%) were women meeting the T-Score ≤ –3.0 SD criterion of the L1–L4 lumbar spine/total hip/femoral neck and the FRAX criterion >15% for MOF or FRAX > 4.5% for HF (52.20%), while 9.43% had a history of multiple (≥ 2) major osteoporotic fractures. A high percentage of patients with a very high fracture risk who met the T-Score criterion resulted from the fact that the study included women who had a T-score ≤ –2.5 SD at one of the 3 main sites (Tab. 6).

Age structure of patients at very high and high risk for HF and MOF

Considering the FRAX results with BMD included, the highest percentage of patients with a very high risk for major osteoporotic fractures (hip, vertebrae, wrist, humerus) were in the age range of 65–70 years, and for patients with a high risk in the age range of 70–75 years (Fig. 1A). There were no statistically significant differences in age between patients with very high and high risk of MOF (respectively Me: 70.00; Q1–Q3: 64.00–74.00 *vs*. Me: 71.00; Q1–Q3: 67.00–77.00) (Fig. 1B, Supplementary File — Tab. S1A). The result was similar for patients with a very high risk for femoral neck frac-

Table 6. *Criteria for qualifying patients to the group with a very high fracture risk*

		N (%)	FRAX	
			HF	MOF
			Median (Q1–Q3)	Median (Q1–Q3)
All patients		159 (100.00%)	4.40 (1.80–6.60)	11.00 (6.40–15.00)
Very high fracture risk 1 of 3 criteria fulfilled:		115 (72.33%)		
History of multiple fractures ≥ 2	Yes	15 (9.43%)	6.00 (2.40–9.00)	14.00 (9.10–18.00)
	No	144 (90.57%)	4.05 (1.70–6.60)	11.00 (6.10–15.00)
Low T-Score ≤ – 3.0	Yes	83 (52.20%)	5.80 (2.90–8.60)	12.00 (7.90–17.00)
	No	76 (47.80%)	2.95 (1.55–5.35)	9.75 (5.60–13.00)
FRAX > 15% for MOF or FRAX > 4.5% for HF	Yes	83 (52.20%)	6.70 (5.80–9.60)	15.50 (13.00–19.00)
	No	76 (47.80%)	1.90 (1.10–3.00)	6.60 (4.40–9.10)

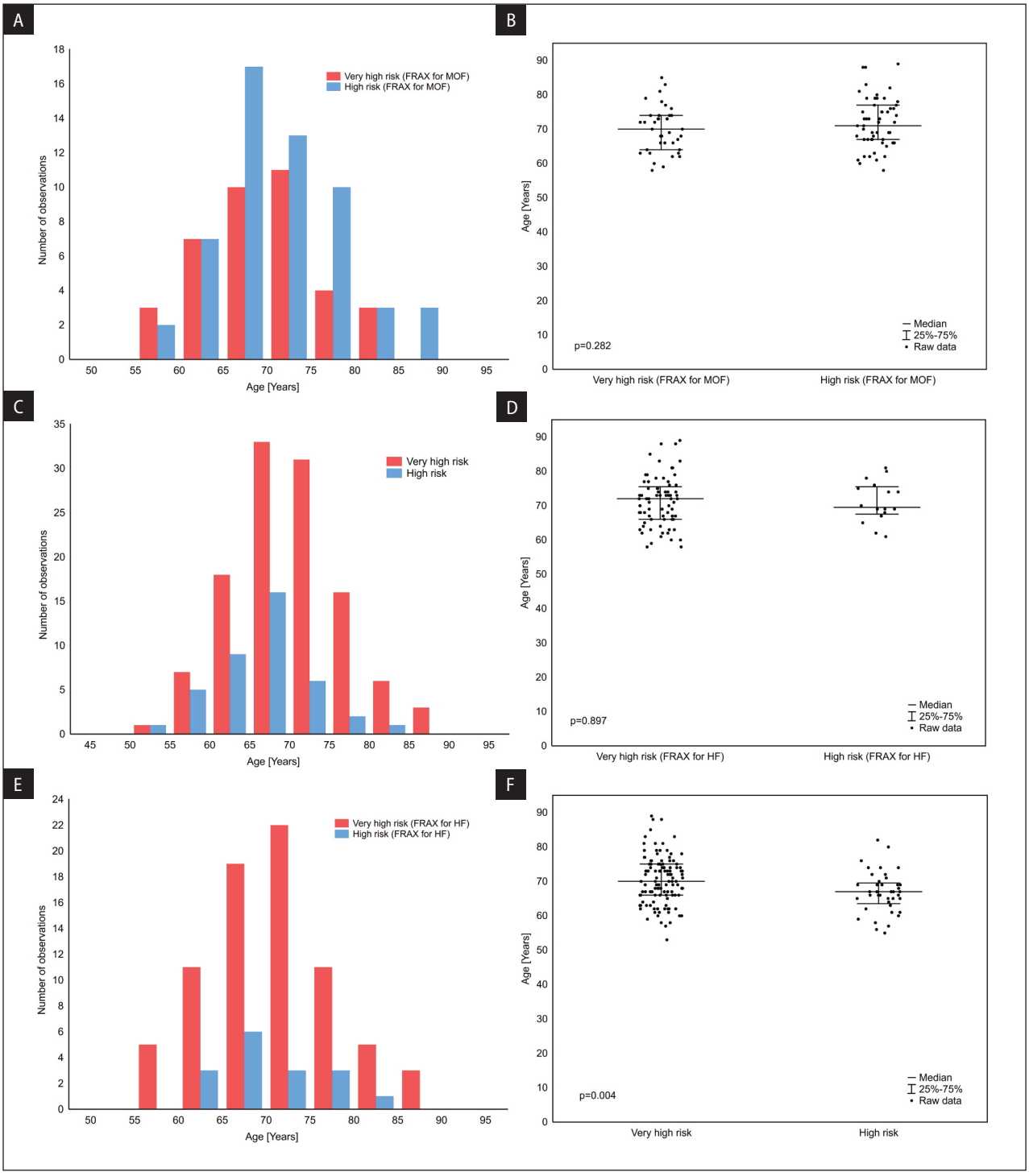

Figure 1. *Number of women at a very high and high 10-year risk (histogram) and age differences between the very high-risk and high-risk groups (box-plot) for major osteoporotic fractures (***A**, **B***); hip fracture (***C**, **D***); extended assessment criteria (***E**, **F***)*

ture, with the highest percentage occurring in the age range of 70–75 years, whereas high risk for femoral neck fracture was highest in the age range of 65–70 years (Fig. 1C). No statistically significant differences were found for these groups either (very high risk *vs*. high risk: Me: 72.00; Q1–Q3: 66.00–75.50 *vs*. Me: 69.50; Q1–Q3: 67.50–75.50) (Fig. 1D, Supplementary File — Tab. S1B). Analysis of the percentage of patients with either very high or high fracture risk according to the expanded assessment criteria showed that the highest number of observations occurred for the of age 65–70 years (Fig. 1E). Additionally, it was shown that patients with very high risk had a statistically significantly greater age (Me: 70.00; Q1–Q3: 66.00–75.00)

compared to patients with high risk (Me: 67.00; Q1–Q3: 63.50–69.50, p = 0.004) (Fig. 1F, Supplementary File — Tab. S1C).

Discussion

The aim of our study was to assess fracture risk in patients with newly diagnosed osteoporosis and establish the percentage of patients at high and very high fracture risk. To individually assess probability of fracture in each patient, it is necessary to take their medical history to identify fracture risk factors, especially the most relevant ones as specified by the World Health Organisation (WHO), and then conduct an analysis using the FRAX calculator. It allows for classifying the patient into one of 4 risk groups and determining the adequate type of treatment. The results of our study show that the most common risk factor was a history of fracture. More than half of the patients (56.60%) had sustained at least one fracture in adulthood. Among the other risk factors, smoking (21.38%) dominated, followed by parental hip fracture (13.21%) and taking glucocorticoids (10.70%). Similar results were obtained in a study by McCloskey et al. [12], in which a previous fracture was also the most common risk factor. The prevalence was similar in all countries (from 27.3% in France to 33.3% in Slovakia), except for Switzerland, which had a relatively high percentage of fractures compared to other countries (46.8%). In the Polish population, a fracture occurred in 30.9% of individuals, with the highest incidence of wrist fractures (13.7%) and other fractures (14.7%). The other risk factors varied widely for each country. In Poland, the highest percentage rates were recorded for parental hip fracture (8.2%), smoking (5.5%), and use of glucocorticoids (4.2%).

A previous fracture is a highly significant, if not the main, risk factor for subsequent fractures. The elapsed time since the fracture is equally important, as is the type of fracture itself. In a large cohort study involving 18,872 people, the risk for another major osteoporotic fracture (MOF) within a year of the first one was 2.7 times greater than the population risk. This risk then decreased over time, although even after 10 years it remained higher than the population risk throughout the follow-up period. Among those who had sustained a fracture, in 20% a re-fracture occurred within the next year and in 34% within 2 years [13]. Similar observations have been reported in several other studies [14–18], with one demonstrating up to a fivefold higher risk for fracture occurring within a year following a previous one [19]. It is already known that practically any type of fragility fracture is associated with an immediate increase in the risk for re-fracture [20], but the degree of this risk varies depending on the location of the previous fracture. In our study, the highest percentage of fractures affected the spine (38.89%) and the wrist (34.44%). The analysis of data from several studies showed that among patients with vertebral fracture, the incidence of subsequent fractures within one to two years is the highest [21–23]. Additionally, it increases dramatically with the number of fractured vertebrae. In contrast, patients with wrist fractures show a lower absolute risk compared to fractures of other parts of the skeleton [22, 23].

It is important to assess fracture risk in patients with newly diagnosed osteoporosis to implement the correct treatment and monitor disease progression. There are a lot of effective fracture risk assessment tools, such as FRAX, to determine each patient's individual risk. In our study, 47.80% of the patients with newly diagnosed osteoporosis were found to be at a very high risk for HF, and 23.90% met the criteria for a very high risk for MOF in the next 10 years. In contrast, a high risk for HF was recorded in 10.06% of the patients and in 34.59% for MOF. On the 10-year scale, the medium and low fracture risk for MOF was 25.79% and 15.72%, respectively. Similar results were obtained in an Austrian study, in which risk assessment using the FRAX tool, including BMD, showed that 26.5% of women were at high risk and 22.9% at very high risk for MOF. The percentage of those at very high risk increased to 28.1% when the probability of hip fracture was additionally considered. Preliminary results of the Ministry of Health's Operational Program Knowledge Education Development — POWER, entitled "Coordination of Osteoporotic Fracture Prevention", which ended in 2023, show that in a group of 6560 women aged 50–70 years previously undiagnosed for osteoporosis, 38% of those with a medium risk and 7% with a high risk for fractures were identified, based on the FRAX PL score, without taking BMD into account. Further densitometric diagnosis using DXA confirmed osteopaenia or osteoporosis averagely in 66% of patients. In the high-risk group, the percentage was higher (68%), and DXA confirmed osteoporosis in about 41.6% [24, 25].

The results of our analysis showed that the percentage of individuals at very high risk for fractures increases if the expanded assessment criteria are applied, as proposed by experts for the Polish population. It was noticed that, with the expanded criteria applied, significantly more subjects (72.33%) were classified into the very high fracture risk group than in the case of using the FRAX score alone (23.90% for MOF, 47.80% for HF). Analysis of the individual criteria showed that most women met the T-Score criterion ≤ –3.0 SD (52.20%) and the FRAX criterion > 15% for MOF or FRAX > 4.5% for HF (52.20%), while the fewest (9.43%) had a history of multiple (≥ 2) major osteoporotic

fractures. Certainly, the high percentage of patients at very high risk for fractures that met the T-Score criterion resulted from the fact that the study included patients with a T-score ≤ –2.5 SD at one of the 3 main sites. Slightly different results were obtained in an observational study conducted in 8 European countries (including Poland), in which 2077 patients (55%) met at least one of the 3 criteria for increased fracture risk. In this group, 1200 patients had sustained a previous fracture, 1814 exceeded the FRAX threshold specific to their country, and 318 had a T-score ≤ –2.5 SD. In those with a higher fracture risk, the median of the 10-year probability of an osteoporotic fracture occurrence was 11.2% for HF and 22.8% for MOF. The fracture risk in those identified based on the FRAX score, whether alone or in combination with other criteria, was consistently higher than in those identified with the FRAX score not being considered. However, in contrast to our results, only a small percentage of patients met the criterion of an increased fracture risk based on T-score alone (4.0%), which reflects the fact that BMD measurements were taken in a small number of patients (24.9%) [26].

There is a strong inverse relationship between BMD and fracture risk. Studies show that each 1 SD decrease in BMD is associated with a 2-fold or 3-fold increase in the risk for hip fracture and about a 1.5-fold increase in the risk for all non-vertebral fractures. Low BMD is also a predictor of fractures in the next one to two years. Both the most recent Polish guidelines and those issued by the American Association of Clinical Endocrinologists (AACE) [7] suggest that a T-Score ≤ –3.0 SD may help identify patients at very high risk for fractures. However, there are opinions that a T-score ≤ –3.0 SD alone, with no other predictive factors considered (such as previous fractures, advanced age, high risk for falls, or use of corticosteroids), should not be a clear criterion indicating a very high risk for fractures [22–29].

If we analyse the number of women in each age group in our study population, we observe that the highest percentage of patients with a very high risk for major osteoporotic fractures (hip, vertebrae, wrist, humerus) falls within in the age range of 65–70 years, while patients at high risk are primarily in the 70–75 year age group. We observed similar results for patients with a very high risk of femoral neck fracture, with the highest percentage occurring in the age range 70–75 years, whereas the high risk of femoral neck fracture was highest in the age range 65–70 years. In contrast, analysis of the percentage of patients with both very high and high fracture risk according to the expanded assessment criteria showed that the highest number of observations occurred for the of age 65–70 years. Additionally, it was shown that patients with very high risk had a statistically significantly greater age compared to patients with high risk. Our analysis shows that female patients aged 65–70 and 70–75 years are at greatest risk for fractures and qualify for anabolic therapy. According to the recommendations, anabolic medications should be considered as first-line treatment in patients at a very high risk for fractures. Key data from several head-to-head trials indicate that anabolic therapy leads to faster and more significant reductions in the risk for non-vertebral fractures, as well as greater reductions in the risk for vertebral fractures compared with antiresorptive drugs within one to two years of treatment [10, 30, 31]. Additionally, bone mineral density (BMD) gains are greater with sequential treatment beginning with bone-forming agents followed by antiresorptive drugs than with a reverse therapy regimen [32, 33].

When analysing the results of our study, some limitations should be mentioned. Firstly, the participants were selected based on the DXA result only; thus, patients with diagnosed postmenopausal osteoporosis with T-score ≤ –2.5 SD were included in the study, and those with densitometric features of osteopaenia, although they may meet the criteria for clinical osteoporosis, were excluded. We are considering conducting a similar analysis among female patients with osteopaenia to verify whether their exclusion from the study had any impact on the results and final conclusions. Secondly, the study included only women, based on data from the first appointment at the outpatient clinic. In the future, the study could be expanded to include the male population with simultaneous one-year follow-up and analysis of the treatment administered.

To sum up, the results of our study emphasise the importance of stratifying patients based on fracture risk assessment and indicate that the number of patients at very high risk for fracture increases with the application of the expanded assessment criteria proposed in the latest guidelines for the Polish population. Early identification of patients at very high risk for fractures allows for implementation of effective therapeutic strategies including anabolic treatment, which can significantly improve quality of life and reduce the risk of fractures.

Data availability statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics statement

This retrospective study not require the consent of the bioethics committee.

Author contributions

W.S-K. conceived and designed the analysis, collected the data, wrote the manuscript; M.M-K. contributed data, helped supervise

the study; K.P. performed the statistical analysis , M.S. contributed to the interpretation of the results and E.S. supervised the findings of this work, revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

Funding
No funding was received to assist with the preparation of this work.

Acknowledgments
N/A

Conflict of interest
The authors report there are no competing interests to declare.

Supplementary material
Supplementary material is available in the additional attachment.

References

1. Willers C, Norton N, Harvey NC, et al. SCOPE review panel of the IOF. Osteoporosis in Europe: a compendium of country-specific reports. Arch Osteoporos. 2022; 17(1): 23, doi: 10.1007/s11657-021-00969-8, indexed in Pubmed: 35079919.
2. Narodowy Fundusz Zdrowia. Narodowy Fundusz Zdrowia. NFZ o Zdrowiu: Osteoporoza. Centrala Narodowego Funduszu Zdrowia, Departament Analiz i Strategii, Warszawa 2019.
3. Narodowy Fundusz Zdrowia. NFZ o Zdrowiu: Osteoporoza. Centrala Narodowego Funduszu Zdrowia, Departament Analiz i Strategii, Warszawa 2023; Narodowy Fundusz Zdrowia: NFZ o zdrowiu. Osteoporoza. https://ezdrowie.gov.pl/portal/home/badania-i-dane/zdrowe-dane/raporty/nfz-o-zdrowiu-osteoporoza.
4. Głuszko P, Sewerynek E, Misiorowski W, et al. Guidelines for the diagnosis and management of osteoporosis in Poland. Update 2022. Endokrynol Pol. 2023; 74(1): 5–15, doi: 10.5603/EP.a2023.0012, indexed in Pubmed: 36847720.
5. Głuszko P. Osteoporoza — postępy 2023/2024. Med Prakt. 2024; 4: 71–77.
6. Kanis JA, Harvey NC, McCloskey E, et al. Algorithm for the management of patients at low, high and very high risk of osteoporotic fractures. Osteoporos Int. 2020; 31(1): 1–12, doi: 10.1007/s00198-019-05176-3, indexed in Pubmed: 31720707.
7. Camacho PM, Petak SM, Binkley N, et al. American Association of Clinical Endocrinologists/American College of Endocrinology Clinical Practice Guidelines for the Diagnosis and Treatment of Postmenopausal Osteoporosis — 2020 Update. Endocr Pract. 2020; 26(Suppl 1): 1–46, doi: 10.4158/GL-2020-0524SUPPL, indexed in Pubmed: 32427503.
8. Miyauchi A, Hamaya E, Shimauchi J, et al. Effectiveness of romosozumab in patients with osteoporosis at high fracture risk: a Japanese real-world study. J Bone Miner Metab. 2024; 42(1): 77–89, doi: 10.1007/s00774-023-01477-0, indexed in Pubmed: 38086988.
9. Kendler DL, Marin F, Zerbini CAF, et al. Effects of teriparatide and risedronate on new fractures in post-menopausal women with severe osteoporosis (VERO): a multicentre, double-blind, double-dummy, randomised controlled trial. Lancet. 2018; 391(10117): 230–240, doi: 10.1016/S0140-6736(17)32137-2, indexed in Pubmed: 29129436.
10. Saag KG, Petersen J, Grauer A, et al. Romosozumab or Alendronate for Fracture Prevention in Women with Osteoporosis. N Engl J Med. 2017; 377(15): 1417–1427, doi: 10.1056/NEJMoa1708322, indexed in Pubmed: 28892457.
11. FRAX ®Kalkulator ryzyka złamania. https://frax.shef.ac.uk/FRAX/tool.aspx?lang=po.
12. McCloskey E, Rathi J, Heijmans S, et al. Prevalence of FRAX risk factors and the osteoporosis treatment gap among women≥70 years of age in routine primary care across 8 countries in Europe. Arch Osteoporos. 2022; 17(1): 20, doi: 10.1007/s11657-021-01048-8, indexed in Pubmed: 35064844.
13. Johansson H, Siggeirsdóttir K, Harvey NC, et al. Imminent risk of fracture after fracture. Osteoporos Int. 2017; 28(3): 775–780, doi: 10.1007/s00198-016-3868-0, indexed in Pubmed: 28028554.
14. Söreskog E, Ström O, Spångéus A, et al. Risk of major osteoporotic fracture after first, second and third fracture in Swedish women aged 50 years and older. Bone. 2020; 134: 115286, doi: 10.1016/j.bone.2020.115286, indexed in Pubmed: 32070789.
15. Wong RM, Wong PY, Liu C, et al. The imminent risk of a fracture-existing worldwide data: a systematic review and meta-analysis. Osteoporos Int. 2022; 33(12): 2453–2466, doi: 10.1007/s00198-022-06473-0, indexed in Pubmed: 35776148.
16. Center JR, Bliuc D, Nguyen TV, et al. Risk of subsequent fracture after low-trauma fracture in men and women. JAMA. 2007; 297(4): 387–394, doi: 10.1001/jama.297.4.387, indexed in Pubmed: 17244835.
17. Giangregorio LM, Leslie WD. Manitoba Bone Density Program. Time since prior fracture is a risk modifier for 10-year osteoporotic fractures. J Bone Miner Res. 2010; 25(6): 1400–1405, doi: 10.1002/jbmr.35, indexed in Pubmed: 20200950.
18. Nymark T, Lauritsen JM, Ovesen O, et al. Short time-frame from first to second hip fracture in the Funen County Hip Fracture Study. Osteoporos Int. 2006; 17(9): 1353–1357, doi: 10.1007/s00198-006-0125-y, indexed in Pubmed: 16823545.
19. van Geel TA, van Helden S, Geusens PP, et al. Clinical subsequent fractures cluster in time after first fractures. Ann Rheum Dis. 2009; 68(1): 99–102, doi: 10.1136/ard.2008.092775, indexed in Pubmed: 18677009.
20. Silva BC, Madeira M, d'Alva CB, et al. Definition and management of very high fracture risk in women with postmenopausal osteoporosis: a position statement from the Brazilian Society of Endocrinology and Metabolism (SBEM) and the Brazilian Association of Bone Assessment and Metabolism (ABRASSO). Arch Endocrinol Metab. 2022; 66(5): 591–603, doi: 10.20945/2359-3997000000522, indexed in Pubmed: 36191263.
21. Toth E, Banefelt J, Åkesson K, et al. History of Previous Fracture and Imminent Fracture Risk in Swedish Women Aged 55 to 90 Years Presenting With a Fragility Fracture. J Bone Miner Res. 2020; 35(5): 861–868, doi: 10.1002/jbmr.3953, indexed in Pubmed: 31914206.
22. Adachi JD, Brown JP, Schemitsch E, et al. Fragility fracture identifies patients at imminent risk for subsequent fracture: real-world retrospective database study in Ontario, Canada. BMC Musculoskelet Disord. 2021; 22(1): 224, doi: 10.1186/s12891-021-04051-9, indexed in Pubmed: 33637078.
23. Balasubramanian A, Zhang J, Chen L, et al. Risk of subsequent fracture after prior fracture among older women. Osteoporos Int. 2019; 30(1): 79–92, doi: 10.1007/s00198-018-4732-1, indexed in Pubmed: 30456571.
24. Nowakowska-Płaza A, Zielińska E, et al. Identyfikacja osób zagrożonych złamaniami osteoporotycznymi jest łatwa, szybka i skuteczna – mamy na to dowody. Prakt Ortop Traumat. 2023; 4: 8–18.
25. Narodowy Instytut Geriatrii, Reumatologii i Rehabilitacji: Program profilaktyki osteoporozy — omówienie. https://youtu.be/rNRgQD2uaD0.
26. McCloskey E, Rathi J, Heijmans S, et al. The osteoporosis treatment gap in patients at risk of fracture in European primary care: a multi-country cross-sectional observational study. Osteoporos Int. 2021; 32(2): 251–259, doi: 10.1007/s00198-020-05557-z, indexed in Pubmed: 32829471.
27. Adachi JD, Berger C, Barron R, et al. Predictors of imminent non-vertebral fracture in elderly women with osteoporosis, low bone mass, or a history of fracture, based on data from the population-based Canadian Multicentre Osteoporosis Study (CaMos). Arch Osteoporos. 2019; 14(1): 53, doi: 10.1007/s11657-019-0598-x, indexed in Pubmed: 31098708.
28. Hannan MT, Weycker D, McLean RR, et al. Predictors of Imminent Risk of Nonvertebral Fracture in Older, High-Risk Women: The Framingham Osteoporosis Study. JBMR Plus. 2019; 3(6): e10129, doi: 10.1002/jbm4.10129, indexed in Pubmed: 31346561.
29. Bonafede M, Shi N, Barron R, et al. Predicting imminent risk for fracture in patients aged 50 or older with osteoporosis using US claims data. Arch Osteoporos. 2016; 11(1): 26, doi: 10.1007/s11657-016-0280-5, indexed in Pubmed: 27475642.
30. Ramchand SK, David NL, Leder BZ, et al. Response to Therapy With Teriparatide, Denosumab, or Both in Postmenopausal Women in the DATA (Denosumab and Teriparatide Administration) Study Randomized Controlled Trial. J Clin Densitom. 2016; 19(3): 346–351, doi: 10.1016/j.jocd.2016.01.004, indexed in Pubmed: 26900146.
31. Bone HG, Cosman F, Miller PD, et al. ACTIVExtend: 24 Months of Alendronate After 18 Months of Abaloparatide or Placebo for Postmenopausal Osteoporosis. J Clin Endocrinol Metab. 2018; 103(8): 2949–2957, doi: 10.1210/jc.2018-00163, indexed in Pubmed: 29800372.
32. Cosman F, Kendler DL, Langdahl BL, et al. Romosozumab and antiresorptive treatment: the importance of treatment sequence. Osteoporos Int. 2022; 33(6): 1243–1256, doi: 10.1007/s00198-021-06174-0, indexed in Pubmed: 35165774.
33. Cosman F, Nieves JW, Dempster DW. Treatment Sequence Matters: Anabolic and Antiresorptive Therapy for Osteoporosis. J Bone Miner Res. 2017; 32(2): 198–202, doi: 10.1002/jbmr.3051, indexed in Pubmed: 27925287.