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Improving identification of women at high-risk for osteoporosis in primary care – results from 2,051 cases in a regional screening initiative

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Abstract

Introduction and Objective. It is estimated that 80% of patients with low-trauma fractures leave the hospital without diagnosis and treatment for osteoporosis. Over 20% of hip fracture patients die within a year, and 25% are left dependent. The primary aim of the study is to evaluate the outcomes of a coordinated primary care screening programme designed to identify postmenopausal women at increased risk of osteoporotic fractures. The second aim is to assess the practical usefulness of FRAX as a triage tool for referral to specialist evaluation.

Materials and Method. The records of 2,051 women aged 50–69 years without a prior diagnosis of osteoporosis or osteopenia were analyzed. After initial screening at primary care, the 10-year fracture risk was assessed using FRAX. Eligible patients were referred to a specialist centre, where further diagnostics were performed, and recommendations made to the family physician.

Results. In Stage I, 59.1% of women had a moderate (5–10%) or high (>10%) 10-year fracture risk. A total of 1,126 patients were referred to Stage II, and 850 completed the evaluation. Osteoporosis was diagnosed in 41.8%, osteopenia in 39.4%, and normal results was found in only 17.8%. FRAX >10% was associated with a higher probability of osteoporosis than FRAX 5–10%, but the association was weak. The cumulative risk of bone mineral density deficiency was higher in the high-risk group. Diagnosing low-trauma fractures in primary care had low sensitivity (15.9%) and high specificity (93.4%).

Conclusions. The programme revealed a high prevalence of unrecognized osteoporosis and osteopenia in postmenopausal women. FRAX is a useful screening tool in primary care, but it does not replace DEXA. The results show the need for better education of primary care physicians and coordination of care to reduce the treatment gap in osteoporosis.

Key words

primary care, osteoporosis, screening, FRAX, osteopenia, prevention programme, low energy fracture

INTRODUCTION

Despite constantly increasing diagnostic and treatment options, osteoporosis and the associated risk of fractures remain one of the main global health burdens [1]. The disease is widely underdiagnosed, with almost 80% of patients with a low-trauma fracture discharged from hospitals without diagnosis or treatment [2]. These findings raise significant concerns. According to statistics, the first low-trauma fracture in any location increases the risk of subsequent fractures by nearly 90% [3]. The problem is severe: over 20% of patients with a hip fracture die within a year, and 25% remain dependent [4]. Given the importance of the problem, the gold standard for osteoporosis treatment should be to diagnose the disease and provide pharmacological treatment before the first fracture. If a fracture already exists, treatment should begin as soon as possible to prevent further ones, usually largely preventable with early diagnosis and treatment. The difficulty in diagnosing osteoporosis stems from its prolonged asymptomatic phase. The first fracture, often due to inadequately low forces, is usually the initial osteoporosis sign [5]. It is not only the widespread under diagnosis and under treatment of patients at very high risk of fracture that is alarming, but also the downward trend in pharmacological treatment of those with low-energy fractures. This phenomenon is observed in the populations of both Europe and the United States [6], and its costs extend beyond those associated with the reduced quality of life and frequent disability of those affected by fractures. The economic costs are also extremely high. Pharmacological treatment for patients is much cheaper than surgical treatment for fractures, which in Europe alone reaches billions of euros. The long-term burden on healthcare systems associated with caring for a person with a disability is also worth noting [7]. The situation arises from several factors: health care managers and providers do not prioritize osteoporosis as a significant threat to the health of the population, doctors often underestimate the importance of the problem, and patients lack awareness of their risk. An additional factor is the difficulty in identifying particularly at-risk groups in the general population. While the high-risk group (perimenopausal women) is understand, the real challenge is identifying those in whom bone resorption will progress rapidly, quickly deteriorating the quality of bone. Referring

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the whole postmenopausal population to specialized centres for a comprehensive diagnosis is impractical. That is why the development and implementation of specialized screening tools can help the right patients to be identified for further evaluation and treatment.

The Fracture Risk Assessment Tool (FRAX) was created by a team collaborating with the WHO, with the assumption of developing a simple and reliable tool for assessment in settings without access to densitometry [8]. Based on local population data, FRAX algorithms estimate the 10-year fracture risk at the femoral neck and other key sites (spine, forearm, humerus). This allows for the identification of patients at risk of fragility fractures within the general population [9]. Its simplicity, ease of use, short completion time, and minimal training requirements make FRAX particularly suitable for screening in busy primary care settings.

MATERIALS AND METHOD

The study represents an analysis of a regional screening and prevention programme rather than a population-based epidemiological survey. The study analyzed records of 2,051 patients from the Lublin Province in eastern Poland who participated in the 'Healthy Bones for Old Age' project – an innovative pilot in the eastern Poland macroregion. The programme aimed to counter fragmented patient care, coordinate osteoporosis prevention, and establish an effective system for primary care physicians. The goal was to help them identify patients at high risk of low-energy fractures or those with existing fractures, and refer them to a specialized centre for diagnosis, prevention, and treatment of osteoporosis. Participation in the programme was voluntary. Inclusion criteria included females, age 50–69 years, no prior diagnosis of osteoporosis or osteopenia, and no treatment for osteoporosis at the time of study entry. Exclusion criteria included lack of consent to participate in the study, prior diagnosis of osteoporosis or osteopenia, and treatment for osteoporosis at the time of study entry. After initial qualification, the patients were referred to a general practitioner clinic. Primary care teams conducted interviews and determined patients' 10-year fracture risk using the Fracture Risk Assessment Tool (FRAX). Prior to the start of the programme, the enrolled primary health care workers completed a short, one-day training on epidemiology, prevention, pathophysiology, diagnosis, and treatment of osteoporosis, as well as on the use of the FRAX form. In total, over 160 people from 47 centres were trained. None of them had previous knowledge about FRAX use.

After primary assessment, patients with a FRAX score ≥ 10% for major fractures, ≥ 3 for the proximal femur, or ≥ 5% for major fractures with other risk factors were referred for extended diagnostics at osteoporosis centre. At this stage, the patients underwent a detailed assessment by expert specialists, including a DEXA scan and X-rays. Patients without findings and those diagnosed with osteopenia received individualized education on diet, supplementation, physical activity, and follow-up frequency, emphasizing the personalized care of the programme. Patients diagnosed with osteoporosis received additional recommendations regarding anti-osteoporotic pharmacotherapy. After that stage, according to the program's assumptions, patients should return to the primary care doctor's office to follow the specialist's recommendations. The intervention flow chart is presented in Figure 1.

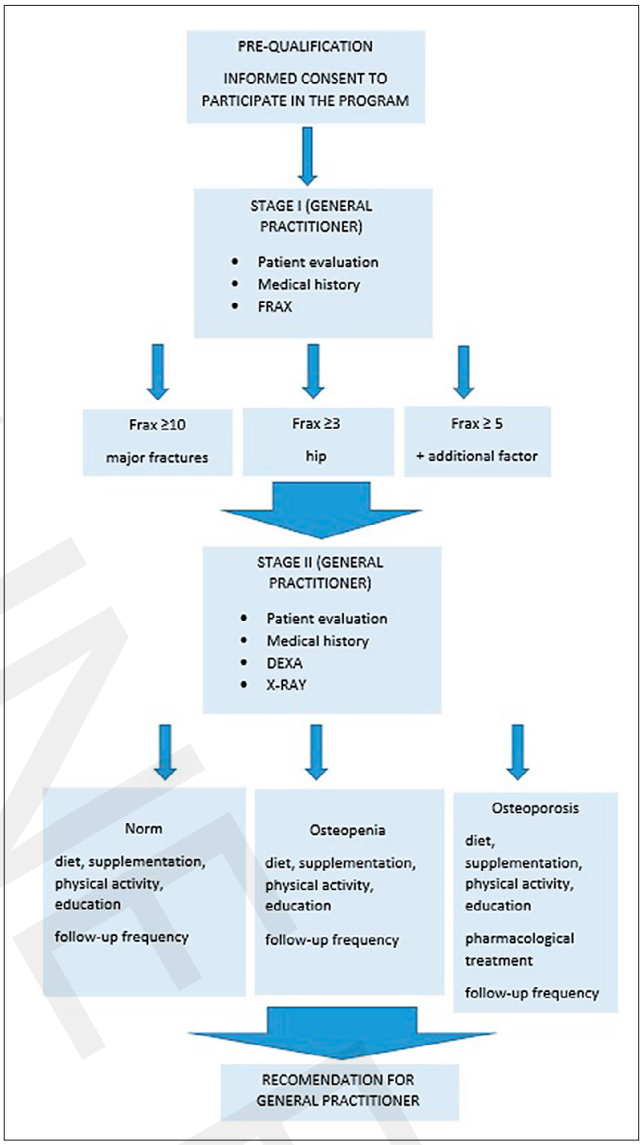

Figure 1. Intervention flow chart

Statistical analysis. Despite 3 levels of the Frax coefficient qualifying patients for the second stage of the programme (FRAX score ≥ 10% for major fractures, ≥ 3 for the proximal femur, or ≥ 5% for major fractures), none of the qualifying stuff used the second option (≥ 3 for the proximal femur), therefore it is absent from the analyses.

Data were analyzed using descriptive statistics and the evaluation of relationships between variables. Results are shown as absolute numbers and percentages. The χ^2 test of independence assessed the association between fracture risk categories based on FRAX (5–10% and >10%) and DXA results, with Cramér's V used to assess the strength of association. To evaluate clinical effect, odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for patients with FRAX >10% compared with the reference group (FRAX 5–10%) for osteoporosis, osteopenia, and the combined bone mineral density (BMD) deficiency category. The predictive value of FRAX for the occurrence of fragility fractures was determined using ROC curve analysis. The area under the

curve (AUC) was calculated, along with the 95% CI and the significance level, and the optimal cut-off point was determined using the Youden J index, which balances test sensitivity and specificity. The concordance between primary care physicians' diagnoses of low-energy fractures in stage I and the specialist's diagnosis in stage II (the gold standard) was assessed using a 2×2 table. The McNemar test was used to compare the proportions of diagnoses, and the concordance matrix was used to calculate sensitivity, specificity, positive and negative predictive values, overall classification accuracy, and Cohen's kappa coefficient as a measure of agreement between assessments. A statistical significance level of $p < 0.05$ was used for all analyses. Calculations were performed using Statistica 14.1.0.4 (TIBCO, Software Paolo Alto, CA, USA), SIMCA 18.0.0.327 (SARTORIUS STEDIM DATA ANALYTICS AB, Umea SWEDEN) and GraphPad Prism (version 10).

Demographic characteristics of the research sample. The study involved 2,051 women aged 50–69 at enrollment (mean 59.5±5.63; median 59). The study group consisted primarily of individuals with upper secondary education (32%) and higher education (31.3%), residing primarily in rural areas (51.6%) and urban areas (37.6%). Most of the participants were employed (54.8%), 40.9% declared economic inactivity, and 4.3% were unemployed, of whom 1.7% were registered with labour offices.

Study eligibility. 2,051 participants qualified for the initial study (Stage I – Primary Care, FRAX, fracture assessment). The criteria for progression to the second stage were a FRAX score above 5% and a risk of low-trauma fractures. Of the entire group, 74 women withdrew from participation, and another 851 patients did not meet the eligibility criteria. Ultimately, 1,126 participants were referred to specialized centres and qualified for the second stage of the study. At this stage, due to a lack of available space (207) and further withdrawals (69), 850 patients completed a full assessment at a highly specialized centre (Stage II – Specialized Centre, DXA, diagnosis).

RESULTS

a) Stage I. 2,051 patients were examined in primary care. FRAX results showed that 59.1% of the study participants had a moderate (5–10%, 45.4%, 932 individuals) or high (above 10%, 13.7%, 281 individuals) risk of fracture. The remaining patients (838) had a low risk of major fracture (below 5%).

Initial testing identified a low-trauma fracture in 94 women, representing 4.6% of the total sample. A total of 819 patients (39.9%) remained undiagnosed, while no fractures were detected in 1,138 women (55.5%). At this stage, 74 women withdrew from the study, and a further 851 were not considered for further study due to failure to meet the criteria. This left 1,126 patients in the study.

b) Stage II. 1,126 patients were qualified for Stage II, of whom 69 (6.1%) withdrew, and another 207 (18.4%) were not accepted to highly specialized centres due to a lack of available space. Ultimately, 850 patients were examined in Stage II (75.5% of the original 1,126). Of the 850 patients, 355 (41.8%) were diagnosed with osteoporosis, 335 (39.4%) with osteopenia, 9 (1.0%) with other conditions, and 151 women (17.8%) had results within the normal range (Fig. 5).

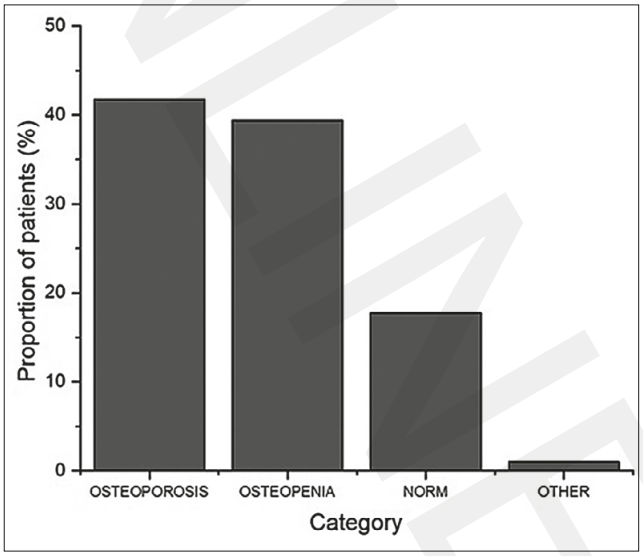

Figure 2. Percentage of patients according to the diagnosis obtained in stage II

A total of 690 patients were diagnosed with osteoporosis and osteopenia, representing 81.2% of the entire study group, highlighting the high prevalence of bone mineral density abnormalities in the analyzed population. Low-energy fractures were observed in 138 patients (16.2%), indicating a clinically significant rate of complications and justifying further evaluation of the predictive value of FRAX in this population.

c) Evaluation of FRAX effectiveness.

FRAX and diagnosis. Of the patients enrolled and examined in the second stage of the project, 667 were in the intermediate-risk group (FRAX score between 5 – 10%), while 183 were at high risk of fractures according to FRAX (FRAX score above 10%).

Among the average-risk group, 265 patients were diagnosed with osteoporosis and 265 with osteopenia, representing 79.4% of the average-risk group and 62.4% of the entire

Table 1. FRAX results (relative to all participants n = 2051)

	Number	Percent
Below 5% (major fractures)	838	40.9
Above 5% (major fractures)	1213	59.1
Included		
Between 5–10% (major fractures)	932	4.4
Above 10% (major fractures)	281	13.7
SUM	**2,051**	**100%**

Table 2. FRAX results with the number of individuals and the percentage of patients (relative to the number of women in each risk group) diagnosed with osteoporosis or osteopenia

FRAX RISK OF FRACTURES	EVALUATION OF A HIGHLY SPECIALISED CENTRE				Σ
	Osteoporosis	Osteopenia	Norm	Other	
Medium risk (5–10%)	265 (39.7%)	265 (39.7%)	129 (19.4%)	8 (1.2%)	**667**
High risk (> 10%)	90 (49.2%)	70 (38.3%)	22 (12.0%)	1 (0.5%)	**183**
Σ	**355**	**335**	**151**	**9**	

group of patients qualified and examined in Stage II of the study. Among the high-risk patients, 90 were diagnosed with osteoporosis (49.2% of the high-risk group), and 70 were diagnosed with osteopenia (38.3% of the high-risk group), representing 18.8% of the entire group examined in Stage II. Results within the normal range were obtained by 129 women at average fracture risk and 22 women classified as high-risk according to FRAX (17.8% of patients examined in stage II). Contingency table analysis revealed a significant association between FRAX fracture risk category and densitometry diagnosis (χ^2 = 8.06; p = 0.045), indicating that in the group with FRAX >10%, osteoporosis was more frequently diagnosed (49.2% vs. 39.7%) and less often the norm (12.0% vs. 19.4%). However, the strength of this association was small (Cramér's V = 0.15), indicating the limited usefulness of FRAX in differentiating patients by densitometry category.

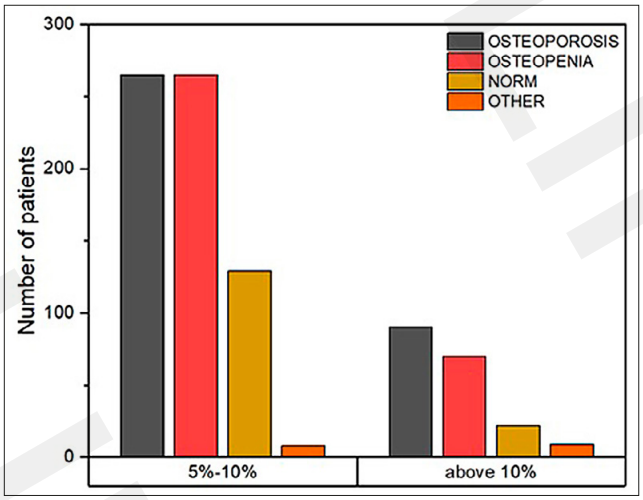

Figure 3. Number of patients with medium (5–10%) or high (above 10%) risk of fracture with diagnosed osteoporosis or osteopenia

Table 3. Relationship of FRAX to DXA diagnosis. CI – confidence interval

Diagnosis	OR	CI	p-value
Osteoporosis	1.47	1.04;2.09	0.030
Osteopenia	0.94	0.66;1.33	0.640
Osteoporosis+Osteopenia1	1.77	1.08;2.91	0.025

Analysis of the association between FRAX category and densitometry results showed that the odds ratio (OR) for patients with FRAX >10% versus FRAX 5–10% for the diagnosis of osteoporosis was 1.47 (95% CI: 1.04–2.09; p = 0.030), indicating a significantly higher probability of detecting osteoporosis among women with FRAX >10%. Osteopenia, however, occurred with similar frequency in both groups (38.3% vs 39.7%), without significant differences (OR = 0.94; 95% CI: 0.66–1.33; p = 0.640). After combining osteoporosis and osteopenia into a common category, the odds of being diagnosed with BMD deficiency were 1.77 times higher in the FRAX >10% group than in the FRAX 5–10% group (95% CI: 1.08–2.91; p = 0.025).

FRAX and fractures. In Stage I, low-trauma fractures were identified in 69 patients who qualified for Stage II. No fractures were detected in the remaining 781. These patients were verified in Stage II, and low-trauma fractures were diagnosed in 138 of the 850 patients examined. The concordance of low-trauma fracture diagnoses (McNemar's test with Yates correction) made in Stage I (by primary care physicians) was compared with the specialist verification in Stage II.

Table 4. Diagnosis of low-energy fracture in the initial examination and confirmed by tests at a specialist centre for a group of 850 patients qualified and examined in stage II

Diagnosis I stage	Diagnosis II stage	
	Yes	No
Yes	22 (TP)	47 (FP)
No	116 (FN)	665 (TN)

McNemar test: χ^2 = 28.4; df = 1; p < 0.001, OR = 0.37 (95% CI: 0.22;0.64)

Concordance analysis in a 2×2 table showed that 22 patients had a concordant positive diagnosis (yes-yes), 665 had a concordant negative diagnosis (no-no), while in 116 cases the fracture was diagnosed only in stage II (false negative in stage I), and in 47 cases the diagnosis was made in stage I but was not confirmed in stage II (false positive). McNemar's test confirmed a significant difference between stages (χ^2 = 28.37; df = 1; p < 0.0001). The odds ratio was OR = 0.37 (95% CI: 0.22–0.64), which means that the odds of a fracture diagnosis in stage I were more than 2.5 times lower than in a specialist diagnosis. Based on the concordance matrix, diagnostic rates for primary care physician diagnoses were calculated relative to specialist diagnoses (the gold standard). Sensitivity was 15.9%, and specificity was 93.4%. The positive predictive value (PPV) was 31.9%, and the negative predictive value (NPV) was 85.1%. Overall classification accuracy was 80.9%, but Cohen's kappa coefficient (κ = 0.16) indicated only weak agreement between stages. In practice, this means that primary care physicians detected only a small proportion of actual fractures (low sensitivity), while they missed fracture diagnoses most often (high specificity and NPV). Positive primary care diagnoses were confirmed by specialists in only about one-third of cases.

DISCUSSION

Since its development, FRAX has been incorporated into guidelines in over 80 countries, but intervention thresholds based on it differ substantially [10, 11, 12]. For the Polish population, a high fracture risk in FRAX values is considered over 10% for major fractures and over 3% for hip fractures [13]. In the presented programme, an additional intermediate intervention threshold of ≥5% for major fractures were assumed.

The main finding of this study is not the diagnostic performance of FRAX but the possibility to find the bridge between primary care doctors and specialists to detect undiagnosed osteoporosis. The stage I results show the scale of under-diagnoses among postmenopausal women at risk of fragility fractures in the study population. Nearly 60% of screened women had a medium or high 10-year fracture risk at the FRAX assessment. The programme included only women undiagnosed for osteoporosis and osteopenia, which indicates a high level of prevalence of hidden disease. These results align with epidemiological data showing that within Europe approximately 71% of high-risk older

woman do not receive adequate evaluation [8], and many patients remain undiagnosed even after a fracture [2]. The osteoporosis treatment gap ranged from 53.1- 90.8% across European countries [14]. Interestingly, despite the inclusion of FRAX in the current Polish recommendations for the diagnosis and treatment of osteoporosis [13], none of the staff at the 47 primary care practice centres trained during the programe had any prior knowledge of its use. This may indicate a gap in the education of family doctors in this field, and the low priority with which they treat osteoporosis treatment. This is consistent with other reports in which family doctors consider osteoporosis as a low priority issue, and even among those who are aware of FRAX, due to different reasons, only 50% declare using it in practice [15, 16]. The key observation in stage II is the high incidence of clinically significant bone densitometry abnormalities among women enrolled to this part of the programme. Of the 850 patients who underwent bone densitometry, 39.4% were diagnosed with osteopenia, and 41.8% with osteoporosis. Overall, more than 80% of women who underwent extended diagnostics had reduced bone density. Because osteoporosis often remains asymptomatic until a fragility fracture occurs, these findings indicate that primary care screening may be highly effective in identifying women at risk [17]. The evaluation of the FRAX calculator's accuracy in assessing the relationship between 10-year fracture risk and densitometry revealed a statistically significant but moderate association. This suggests that FRAX alone is insufficient to distinguish patients with osteopenia from those with osteoporosis. This is evident given that FRAX estimates fracture probability based on clinical risk factors, with or without consideration of bone mineral density (BMD), but does not directly measure bone density. Therefore, this tool should be considered a screening rather than a diagnostic.

On the other hand, reports show that the highest gap in osteoporosis treatment is in countries where the use of FRAX is at the lowest level [14]. For general practitioners, its advantages include simplicity and availability, which allows selection of patients for specialist diagnosis without referring to the entire at-risk population to specialist centres. The results obtained in the current study are consistent with previous reports of lower diagnostic efficacy for both FRAX and densitometry alone, and are in line with the recommendations referring to the need to combine fracture risk assessment using the FRAX followed by densitometry [13, 18, 19, 20]. The high consistency in identifying women at risk of osteoporosis across stage I and stage II indicates that FRAX is an effective screening test, even with a brief, one-time staff training session. The qualification thresholds adopted also appear appropriate; even though the staff selecting patients for stage II completely omitted one of the qualification criteria (≤3 for hip fractures), suggesting the need for greater attention to this aspect in any future training.

In both primary and secondary prevention of fractures, a significant discrepancy between the number of people at high risk of fracture and those who actually receive appropriate anti-osteoporotic treatment, is common [6]. Among the findings of this study, a very low diagnosis rate of low-energy fractures by primary care physicians compared to highly specialized centres, is worth mentioning. This indicates a still existing gap in the identification of this fracture type at the primary care level [21]. One of the reasons may be the lack of specific symptoms, especially in vertebral fractures, which make them hard to detect without imaging. Non-specific pain associated with fractures may be confused with back pain due to other causes, a common occurrence in this age group. However, failure to diagnose at this stage may lead to delayed treatment which, given the highly increased risk of subsequent fractures [3] and the high mortality rate associated with hip fractures [4], suggests increased emphasis on educating family physicians in this area.

Limitations of the study. The study has several limitations. It used a regional, voluntary screening programme rather than a population-based design, which may have limited the representativeness and introduced selection bias. Furthermore, a significant proportion of participants did not complete the second stage because of withdrawals and limited specialist centre capacity, which could have influenced the results. The study population was limited to women aged 50–69, thereby excluding other high-risk groups. Although the FRAX tool was practical for screening, it has limited capacity to distinguish between osteopenia and osteoporosis. Inconsistencies in its application by primary care staff may also have affected patient selection.

CONCLUSIONS

The preliminary analysis of the programme documentation of the preventive programme conducted in the Lublin Province provided important insights into the value and importance of structured osteoporosis screening programmes implemented in primary health care. The obtained results confirm both the high percentage of undiagnosed patients with osteopenia and osteoporosis among postmenopausal women, and the practical challenges related to the accuracy of identifying low-energy fractures in primary care. The results show a high degree of under-diagnoses of patients with osteoporosis and osteopenia in the study population. This finding is very concerning, considering that the screening was conducted among patients who had never been previously diagnosed, and the programme was voluntary, which may suggest a selection bias toward those who are more health-conscious, and that the problem is even more severe in the natural population. The programme demonstrated the feasibility of coordinated care between primary care physicians and specialist centres. Strictly established referral rules and defined FRAX thresholds enabled better specialist utilization while maintaining broad access to highly specialized centres. Considering that Poland is one of the European countries with the lowest availability of densitometry examinations, such funnelling of patients seems particularly necessary [7, 14, 22].

Despite the limited specialist capacity which prevented all eligible patients from participating in the programme, three-quarters of eligible women underwent comprehensive diagnostic testing. The presented model may therefore provide an effective solution to the lack of coordinated care for patients with osteoporosis.

The study demonstrated that FRAX is a simple and effective screening test that supports the decision to refer a patient to a highly specialized centre, but it should not be used as a substitute for densitometry assessment. Integrating FRAX into primary care, combined with better training for family physicians on the importance and recognition of fragility

fractures and their better access to imaging tests, could significantly improve early diagnosis and help decrease the problem of osteoporotic fractures in aging populations.

Further analysis of the study group should assess the long-term effects of the programme, including the effectiveness of implementing specialist recommendations into family physician practice, adherence to treatment recommendations, fracture reductions, and, in the long term, the impact on patient mortality in the study group. Further studies are needed to determine whether such programmes can reduce incidence of fractures.

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