

Missed Opportunities in Osteoporosis Prevention and Screening in Postmenopausal Women: Risk Profiles and Awareness

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ABSTRACT

Objectives: Osteoporosis (OP) is a major public health issue among postmenopausal women. Despite its high prevalence, awareness and screening practices remain insufficient. This study aims to evaluate OP-related risk factors and awareness levels among postmenopausal women.

Materials and Methods: This prospective study was conducted between August 2023 and April 2024 among patients admitted to the general internal medicine outpatient clinic of a tertiary care hospital. Participants were categorized into two groups: patients with OP and patients without OP (non-OP). OP awareness was assessed using the OP awareness scale.

Results: The study included 206 participants: 101 in the OP group and 105 in the non-OP group. Evaluation of risk factors ($n = 20$) showed no significant difference (SD) in the mean number of risk factors between the groups [OP: 7.29 (1.77), non-OP: 6.71 (1.94), $p > 0.05$]. Both groups demonstrated inadequate physical activity and dietary habits. The OP group demonstrated a higher prevalence of glucocorticoid use, while the non-OP group exhibited a higher prevalence of vitamin D deficiency ($p < 0.01$) and type 2 diabetes ($p = 0.02$). About 35% of the non-OP group have not undergone bone-mineral-density measurements within the last 2 years, and 11% of these individuals were identified as high risk for major osteoporotic fracture within a 10-year timeframe. There was no SD in OP awareness between the groups [mean (SD) scores: OP 61.18 (16.02) and non-OP 61.32 (14.39); $p = 0.44$]. Conversely, risk of OP was positively correlated with patient age ($p = 0.004$), lower awareness score in the protective behavior subdomain ($p = 0.02$), and lower body mass index ($p < 0.001$).

Conclusion: OP prevention and its management require patient-specific strategies that include educational interventions to increase awareness and routine screening for risk factors among postmenopausal women. Pharmacists are well-positioned to identify patients' health-related and educational needs.

Keywords: Osteoporosis, awareness, risk factors, postmenopausal, clinical pharmacist

INTRODUCTION

Osteoporosis (OP) is a silent yet pervasive condition that disproportionately affects women, particularly in the postmenopausal period, due to the decline in circulating estrogen levels, a hormone crucial for bone density maintenance.¹ Recognized as a pressing public health concern, OP leads to the gradual deterioration of bone health and a heightened risk of fractures, often remaining undetected until

such fractures occur.^{2,3} The risk is especially pronounced among postmenopausal women, whose vulnerability is linked to hormonal changes following menopause.⁴ While primary OP is often associated with aging and menopause and is therefore commonly observed in postmenopausal women and older adults of all genders, secondary OP transcends age and gender categories. Characterized by low bone mineral density (BMD), secondary OP increases the risk of fragility fractures

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due to various underlying diseases or medication use.^{5,6} The differentiation between primary and secondary OP not only reflects biomedical classification but also prompts critical analysis of the ways in which gendered expectations and medical discourse impact bone health and aging experiences. As have been highlighted, a biomedical perspective on women's health in later life frequently ignores the sociocultural aspects of aging femininity and physical vulnerability.⁷ Therefore, an approach to understanding OP must take into account both biological mechanisms and the gendered narratives surrounding aging, fragility, and the female body.

Despite its high prevalence, OP remains underrecognized, particularly among postmenopausal women. Many continue to underestimate the significance of preventive measures, remaining unaware of the potential for fractures and other complications associated with progressive bone loss.⁸ While BMD measurement is a key clinical tool in assessing fracture risk,⁹ recent guidelines emphasize that clinical decisions should not rely solely on BMD; rather, a comprehensive evaluation of fracture risk factors is essential.^{10,11} This includes attention to comorbidities, medication use, and lifestyle-related contributors, factors often shaped by socioeconomic status, gendered caregiving roles, and limited access to health education.¹²

Enhancing early awareness, well before a fracture occurs, is thus critical in managing OP effectively.^{12,13} Importantly, knowledge-building interventions must go beyond generic public health messaging to account for how gender, age, and structural inequalities overlap in shaping women's access to information and care. Empowering women with knowledge about OP through culturally and socially sensitive education strategies may enable more proactive approaches to bone health, such as weight-bearing physical activity and adequate intake of calcium and vitamin D.¹⁴

Against this backdrop, the present study aims to evaluate OP-related risk factors and awareness levels among postmenopausal women attending a general internal medicine outpatient clinic.

MATERIALS AND METHODS

This prospective study was conducted between August 2023 and April 2024, targeting postmenopausal women aged 45–64 years (considered a vulnerable group regarding OP prevention) who attended the general internal medicine outpatient clinic of a tertiary care hospital. Women diagnosed with OP prior to menopause or falling outside the specified age range were excluded. Participants were included after providing written informed consent, and ethical approval was obtained from the Hacettepe University Health Sciences Research Ethics Committee (approval number: 2023/04-35; dated 12.09.2023).

The study population consists of postmenopausal women who were admitted to the general internal medicine outpatient clinic at the Hacettepe University Hospital. Since the study was observational in nature, no additional sample size calculation was

performed for any assumption. All patients who met the inclusion criteria during the study period constituted the study sample. The power analysis was performed at the end of the study.

OP risk factors were assessed using a combination of the eleven parameters defined by the World Health Organization-endorsed FRAX tool and nine additional factors identified through a review of recent literature. In line with Fracture Risk Assessment Tool (FRAX) criteria, the study defined 'advanced age' as 55–64 years. The FRAX algorithm was used to estimate the 10-year probability of a major osteoporotic fracture (MOF) in women without a prior diagnosis of OP. When the estimated MOF risk was $\geq 10\%$ and no BMD test had been performed within the last two years, physicians were informed to facilitate appropriate clinical follow-up.

To evaluate participants' awareness of OP, the validated Turkish version of the OP awareness scale (OAS) was administered.^{15,16} The scale comprises 27 items across five subdomains: bone physiology, protective behaviors, risk factors, exercise, and general characteristics of the disease. Scores range from 27 to 108, with higher scores reflecting greater awareness. In addition to the scale, participants responded to 12 questions designed by the research team to assess knowledge of OP-related risks. These questions aimed to capture not only clinical knowledge but also contextual and experiential dimensions of women's understanding of and relationship to their bone health.

Statistical analysis

The data were presented as means and standard deviations or as medians and minimum-maximum values for numerical variables, and as numbers and percentages for categorical variables. The normality assumption was examined by the Shapiro–Wilk test. For group comparisons, a significance test for the difference between two means was performed when parametric test assumptions were met; when they were not, the Mann–Whitney U test was used. The relationship between numerical variables was analyzed using the Pearson correlation test. The significance level was set at $p < 0.05$. All analyses were performed using IBM SPSS v.23.

A post-hoc power analysis was performed using G*Power 3.1 to evaluate the adequacy of the sample size for two separately defined sets of OP risk factors. Among the eleven FRAX-based risk factors, the mean number was 3.73 (SD = 1.06) in the OP group and 2.80 (SD = 1.16) in the non-OP group, yielding a Cohen's d of 0.84. With sample sizes of 101 and 105, respectively, and $\alpha = 0.05$ (two-tailed), the achieved statistical power was $1 - \beta = 1.00$. For the nine literature-based additional risk factors, the mean was 3.56 (SD = 1.35) in the OP group and 2.80 (SD = 1.58) in the non-OP group, corresponding to a Cohen's d of 0.52 and an achieved power of $1 - \beta = 0.96$. Both analyses confirm that the study was sufficiently powered to detect clinically meaningful differences in the burden of OP risk factors between groups.

RESULTS

A total of 206 postmenopausal women were included in the study, of whom 101 were diagnosed with OP and 105 were not. The mean age was slightly higher in women with OP [58.78

(SD: 3.95) years] than in those without OP [57.33 (SD = 4.23) years], although the difference was not statistically significant ($p = 0.26$) (Table 1). The prevalence of chronic diseases differed between the groups: hypertension was more common among women with OP (42.6%), while type 2 diabetes was most frequent among those without OP (46.7%).

Patterns of medication use reflect both clinical need and broader gendered dynamics in aging. Vitamin D3 supplements were the

most frequently used medications in the OP group (55.4%), followed by cardiovascular medications (47.5%) and thyroid medications (33.7%). In contrast, women without OP were most commonly prescribed cardiovascular drugs (50.5%), antidiabetic drugs (44.8%), and dyslipidemia-related drugs (36.2%). Unsurprisingly, use of vitamin D3 and calcium was significantly higher in the OP group ($p < 0.001$ and $p = 0.02$, respectively), while use of antidiabetic medication was more common in the

Table 1. Characteristics of the participants.

	With OP (n = 101)	Without OP (n = 105)	<i>p</i>
	n (%)		
Age (years) mean (SD)	58.78 (3.95)	57.33 (4.23)	0.26
Age of menopause (years) mean (SD)	46.3 (5.02)	47.28 (4.98)	0.68
Early menopause (<45 years)	25 (24.8)	26 (24.8)	0.9
Age of menarche (years) mean (SD)	13.15 (1.33)	13.06 (1.71)	0.05
Duration of breastfeeding (years) mean (SD)	3.22 (2.29)	3.02 (2.35)	0.91
Duration of OP (months) mean (SD)	40.24 (40.91)	-	N/A
Number of drugs used per day mean (SD)	4.69 (3.32)	4.48 (3.54)	0.60
Body mass index (kg/m²)			
<18.5	2 (2)	0 (0)	
18.6–24.9	32 (31.7)	12 (11.4)	<0.001
25–29.9	36 (35.6)	37 (35.2)	
≥30 (obese)	31 (30.7)	56 (53.3)	
Level of education			
No formal education	2 (2)	8 (7.6)	
Primary school	60 (59.4)	61 (58.1)	0.29
High school	24 (23.8)	21 (20.0)	
University	15 (14.9)	15 (14.3)	
Number of births			
None	8 (7.9)	5 (4.8)	
1–3	73 (72.3)	82 (78.1)	0.53
>3	20 (19.8)	18 (17.1)	
Number of comorbid diseases, mean (SD)	3.47 (1.50)	2.91 (1.71)	0.31
Comorbidities			
Type II diabetes	33 (32.7)	49 (46.7)	0.04
Hypertension	43 (42.6)	47 (44.8)	0.75
Hypothyroidism	32 (31.7)	28 (26.7)	0.42
Hyperlipidemia	30 (29.7)	40 (38.1)	0.2
Asthma	8 (7.9)	15 (14.2)	0.14
Coronary artery disease	6 (5.9)	9 (8.6)	0.46
Alkaline phosphatase, median (IQR)	70 (28)	77 (26.5)	0.01

SD, standard deviation; IQR, interquartile range; OP, osteoporosis.

non-OP group ($p = 0.003$). Of the women diagnosed with OP, 57 were receiving pharmacological treatment: of these, 40.5% were prescribed bisphosphonates, 5.9% were prescribed a bisphosphonate-calcium combination, 6.9% were prescribed calcium carbonate alone, 2% were prescribed denosumab, and 1% were prescribed a denosumab-calcium combination. All women who were taking at least one medication received counselling by a clinical pharmacist, reflecting the study's emphasis on comprehensive pharmaceutical care.

Biochemical parameters (albumin, calcium, phosphorus, thyrotid stimulating hormone, glomerular filtration rate, and creatinine) did not differ significantly between the two groups ($p > 0.05$). However, median alkaline phosphatase levels were significantly higher in women without OP ($p = 0.01$), a finding that warrants further investigation. Among women without OP, 65% ($n = 68$) had undergone BMD testing within the past two years (Table 2).¹⁷

Evaluation of risk factors showed that the OP group had averages of 3.73 (SD = 1.06) out of 11 FRAX risk factors and 3.56 (SD = 1.35) out of 9 additional literature-based risk factors. In the non-OP group, the averages were 2.8 (SD = 1.16) and 3.9 (SD = 1.58), respectively. When considering all 20 risk factors, the OP group had a mean of 7.29 (SD = 1.77), and the non-OP group had a mean of 6.71 (SD = 1.94); this difference was not statistically significant ($p > 0.05$). Glucocorticoid use was notably higher among women with OP, while vitamin D deficiency ($p < 0.01$) and type 2 diabetes ($p = 0.02$) were more prevalent among women without OP (Table 3).

Interestingly, post-hoc power analysis (two-tailed independent samples t-test, $\alpha = 0.05$, observed effect size $d = 0.009$) indicated that the statistical power for detecting this difference was negligible ($1-\beta < 0.06$), and overall OP awareness scores did not differ significantly between the groups (Table 4). This near-zero effect size indicates that the lack of a statistically SD (SD) in OP awareness between groups constitutes a substantive finding, suggesting that an OP diagnosis does not meaningfully improve awareness. However, when participants were stratified by educational background, participants with at least a high school education scored significantly higher on the OAS ($p < 0.01$), highlighting the role of educational inequality in shaping health literacy among women.

A weak but statistically significant negative correlation between the total number of OP risk factors and OAS scores (Table 5) suggests that higher risk does not necessarily translate into higher awareness. Logistic regression analysis revealed three variables associated with increased risk of OP: increasing age [odds ratio (OR): 1.17, 95% confidence interval (CI): 1.053–1.306, $p = 0.004$], lower scores in the “protective behaviors” subdomain of the OAS (OR: 0.85, 95% CI: 0.729–0.981, $p = 0.02$), and lower body mass index (BMI) values (OR: 0.81, 95% CI: 0.729–0.891, $p < 0.001$).

Regarding the total patient population ($n = 206$), it is evident that patients are not cognizant that certain medications (e.g., proton pump inhibitors, antidepressants, antiepileptics, hormonal agents, and drugs for thyroid diseases), certain clinical conditions (e.g., gastrointestinal system disorders, rheumatological and endocrine disorders), and reproductive and hormonal factors in women (e.g., vitamin D deficiency, duration of lactation >1 year, >3 pregnancies, and late menarche) can increase the risk of developing OP (Figure 1).

A significant discrepancy was identified when comparing patients' (group of OP versus non-OP) responses to questions assessing their knowledge of OP risk factors. The only SD was found in responses to the question, “Some stomach-protecting medications may increase the risk of OP” ($p = 0.03$). No SD was found in responses to the other questions. In the Kruskal-Wallis analysis conducted to ascertain the relationship between the number of risk factors present in patients and their responses to questions related to risk factors, a SD was identified between the responses to the question “Vitamin D deficiency can increase the risk of OP” and the number of risk factors identified in patients ($p < 0.001$). Patients who responded “I don't know” to this question had a significantly higher number of identified risk factors than those who responded “I know” ($p < 0.001$).

DISCUSSION

Despite the high prevalence of OP among postmenopausal women, this study highlights a persistent gap in both the comprehensive assessment of OP risk factors and the awareness of the condition among affected populations. It is noteworthy that the comparable number of risk factors

Table 2. 10-year probability of fracture (%) in patients without osteoporosis ($n = 105$).

	BMD measurements performed within the last 2 years	
	Yes ($n = 68$)	No ($n = 37$)
	Median (minimum-maximum)	
MOF	4.3 (2.5–12.1)	3.9 (2.5–15)
Hip fracture	0.55 (0–6.5)	0.5 (0.1–1.9)
Patients at risk according to the MOF-FRAX score; ^a	n (%)	
Low risk, $<10\%$ (to be monitored by BMD)	67 (98.5)	33 (89.2)
High risk, $\geq 10\%$ (to be treated)	1 (1.5)	4 (10.8)

^aThe cut off value was accepted as 10% from Kanis et al.¹⁷ 2008. BMD, bone mineral density; MOF, major osteoporotic fracture.

and similar levels of awareness between women with and without OP indicate a potential communication failure between healthcare providers and patients. This emphasises a need for an established pathway that can be facilitated by a pharmacist to ensure ongoing patient care between primary and secondary care.¹⁸

This communication gap likely reflects intersecting barriers related to patients' health literacy, physicians' screening practices, and broader structural factors within healthcare

systems. Existing literature suggests that overcoming these barriers demands proactive risk assessment, adherence to guideline-recommended BMD screenings, and importantly, multidisciplinary interventions, including pharmacist-led education for both clinicians and patients.¹⁹⁻²¹ The finding that over a third of women without OP either lacked recent BMD measurements or had no BMD measurements underscores inequities in access to healthcare and highlights the need for community-based awareness campaigns tailored to the sociocultural realities of women in this demographic.

Table 3. Presence of OP risk factors among the participants.

Risk factors	OP group (n = 101)	Non-OP group (n = 105)	p
Included in the FRAX			
Advancing age (55–64 years)	85 (84.2)	78 (74.2)	0.05
Body mass index (<20 kg/m ²)	5 (4.9)	0	-
Gender (female)	101 (100)	105 (100)	-
Current smoker	19 (18.8)	21 (20)	0.86
Glucocorticoid use	18 (17.8)	7 (6.7)	0.01
Previous fracture	12 (11.9)	0	-
Family history of hip fracture	10 (9.9)	13 (12.4)	0.57
Rheumatoid arthritis	7 (6.9)	4 (3.8)	0.31
Secondary OP [early menopause (<45 years) and chronic liver disease]	27 (26.7)	27 (25.7)	0.87
Alcohol use	0	0	-
BMD	95 (93.1)	40 (38.1)	<0.01
Additional/other risk factors			
Inadequate physical activity (less than 3 x 30 min/week)	58 (57.4)	57 (54.2)	0.65
Lack of healthy eating habits (less than 2 portion of milk or dairy products/day)	55 (54.4)	68 (64.7)	0.13
Vitamin D deficiency (<20 ng/mL)	11 (10.9)	34 (32.4)	<0.01
Comorbid diseases			
Type 2 diabetes	48 (47.5)	58 (55.2)	0.26
SLE/AS	32 (31.7)	49 (46.7)	0.02
IBS/Crohn's/Celiac	2	6	0.16
CKD	1	2	0.58
COPD	1	2	0.58
	-	2	-
Other medicines			
Proton pump inhibitor	53 (52.5)	55 (52.4)	0.55
Levothyroxine	25 (24.8)	22 (21)	0.51
Selective serotonin reuptake inhibitor	11 (10.9)	15 (14.3)	0.46
	32 (31.7)	31 (29.5)	0.73
Late (≥15 years) menarche	14 (13.8)	19 (18.1)	0.4
Number of pregnancies (>3)	20 (19.8)	19 (18.1)	0.75
Long term (>1 year) lactation	76 (75.2)	75 (71.4)	0.53
Bilateral oophorectomy/hysterectomy	25 (24.8)	25 (23.8)	0.87

BMD, bone mineral density.

In this study, we found that 35.2% of women without OP had not undergone a BMD measurement within the past two years or had never been screened during their lifetime. Previous research similarly reports OP screening rates ranging between 20% and 44% among women.^{22,23} While clinical guidelines recommend regular BMD assessments for postmenopausal women aged 65 and over, as well as for younger women presenting risk factors,^{24,25} significant disparities in access to healthcare services, limited awareness of OP risk factors, and variations in physicians' screening practices contribute to inconsistent screening uptake. Therefore, this study identified and characterized the OP risk profiles and awareness gaps in this pre-guideline window where opportunities for early prevention are frequently missed. These disparities often overlap with broader structural inequalities related to gender, socioeconomic status, and healthcare accessibility. Hence, the findings underscore the need for community-based awareness initiatives that are culturally sensitive and tailored to the specific needs and barriers of diverse groups of women. Additionally, a comprehensive evaluation of all OP risk factors in the population is essential to ensure early detection and equitable preventive care.

Menopause heralds a complex metabolic transition, increasing risks not only for OP but also for comorbid conditions such as diabetes and cardiovascular disease, conditions that disproportionately affect women.²⁶ The differential prevalence

of comorbidities and associated medication use observed between the groups further underscores how medical risk factors are shaped by lifestyle, social roles, and healthcare experiences.

Bone loss accelerates during the menopausal transition, with an estimated annual decline of 2% that begins 1 to 3 years prior to menopause and continues for 5 to 10 years. This process culminates in a significant reduction of BMD by about 10–12% in the spine and hip regions.²⁴ The prevalence of comorbidities such as diabetes and hypertension in both study groups suggests a complex interplay between metabolic health and bone integrity during midlife. While obesity is often conceptualized as a risk factor for various metabolic conditions, the present study's finding that women with OP tend to have lower BMIs aligns with emerging evidence on the protective role of adipose-derived estrogen in bone health.^{27,28} Conversely, vitamin D deficiency and type 2 diabetes, more prevalent in the non-osteoporotic group, highlight the complex and sometimes paradoxical nature of risk profiles in postmenopausal women.

OP awareness scores may help identify patients with insufficient knowledge who could benefit from targeted educational interventions. In clinical practice, these scores may support healthcare professionals in prioritizing patient counseling and improving OP prevention strategies. The wide range in OP awareness around the world, from as low as 8%

Table 4. OAS scores.

	OP group	Non-OP group	<i>p</i>
Subdomains	Mean (±SD)		
Bone physiology	13.50 (4.33)	13.7 (4.26)	0.52
Protective behaviors	15.66 (4.6)	15.7 (4.28)	0.48
Risk factors	8.86 (3.44)	8.9 (3.28)	0.65
Exercise	8.46 (3.71)	8.53 (3.38)	0.18
Characteristics of OP	14.72 (3.49)	14.34 (3.36)	0.77
OAS total score	61.18 (16.02)	61.32 (14.39)	0.44

OAS, Osteoporosis Awareness Scale; SD, standard deviation.

Table 5. The relationship between the OAS score and the number of risk factors.

Bone physiology	OAS subgroups					OAS total score	
		Protective behaviors	Risk factors	Exercise	Characteristics OP		
Number of FRAX risks (n = 11)	<i>r</i>	0.030	0.072	0.052	0.076	0.105	0.076
	<i>p</i>	0.665	0.304	0.458	0.276	0.132	0.276
Number of other risks (n = 9)	<i>r</i>	-0.272	-0.292	-0.195	-0.238	-0.327	-0.329
	<i>p</i>	<0.001	<0.001	0.005	<0.001	<0.001	<0.001
Total number of risks (n = 20)	<i>r</i>	-0.195	-0.184	-0.120	-0.138	-0.190	-0.21
	<i>p</i>	0.002	0.005	0.08	0.048	0.006	0.002

OAS, Osteoporosis Awareness Scale.

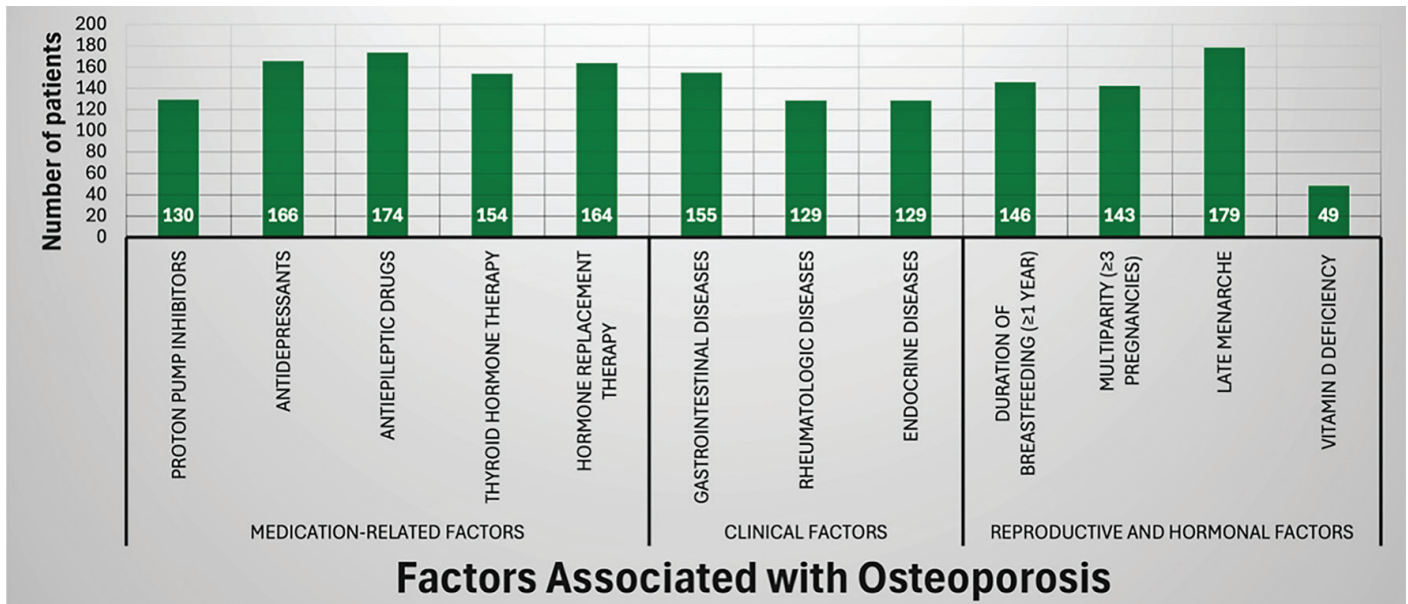


Figure 1. Patients indicated as “I don’t know at all” about OP risk factors. OP, osteoporosis.

to nearly 70% in different countries,¹⁸ highlights the need for educational interventions that are culturally sensitive and tailored to specific contexts. While numerous studies have employed various questionnaires and scales to assess OP awareness and knowledge,^{12,23,29-32} there remains a paucity of research specifically comparing the levels of OP-related knowledge between postmenopausal women with and without the condition. This study emphasizes that women’s knowledge of OP and its associated risks is linked to women’s educational level, which is particularly important at earlier ages to increase awareness and promote self-care.

Study results confirm the impact of aging as a non-modifiable but critical risk factor, while emphasizing modifiable factors such as awareness of protective behaviors and BMI. This highlights the potential for targeted cognitive-behavioral and lifestyle interventions to mitigate OP risks.^{19,33,34} Consistent with previous research, higher OP knowledge or awareness correlates with engagement in protective behaviors, including calcium and vitamin D supplementation, regular exercise, and sufficient consumption of dairy products.^{19,36,37} Nutrition plays a critical protective role; conversely, low BMI contributes to muscle weakness, reduced BMD, and decreased estrogen production from adipose tissue, all of which increase the risk of OP.^{27,28,37-40}

Study limitations

The study has inevitable limitations, such as being conducted at a single center and having a relatively small sample size. However, this study has focused on a comprehensive assessment of risk factors among postmenopausal women, including medical, pharmacological, and lifestyle factors.

CONCLUSION

The postmenopausal period is characterized by accelerated bone loss, which is further exacerbated by risk factors deeply

linked with social, behavioral, and structural determinants of health. This study highlights a critical need for comprehensive assessment of both biological risk factors and OP awareness among postmenopausal women. Effective management of bone health should include not only clinical measures but also culturally modified education and equitable access to screening and preventive services.

Fostering greater awareness and empowering women with knowledge tailored to their experiences and socio-cultural contexts can contribute to reduced fracture risk and improved quality of life.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Hacettepe University Health Sciences Research Ethics Committee (approval number: 2023/04-35; dated 12.09.2023).

Informed Consent: Participants were included after providing written informed consent.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: Ş.G.Ö., Concept: F.Ö., B.K.Ç., Ş.G.Ö., A.B.-E., Design: Ş.G.Ö., A.B.-E., Data Collection or Processing: F.Ö., Analysis or Interpretation: B.K.Ç., Literature Search: F.Ö., B.K.Ç., Writing: F.Ö., B.K.Ç., Ş.G.Ö., A.B.-E.

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