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ORIGINAL RESEARCH

Osteoporosis Screening in Primary Care: Early Implementation Gaps Following the 2023 Saudi Guideline Update

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Objective: To assess adherence to the 2023 Saudi Osteoporosis Society (SOS) universal screening guideline among adults aged ≥60 years in an academic primary care center and identify factors associated with DEXA ordering.

Methods: A retrospective EMR-based study included 2186 patients aged ≥60 years attending a university-affiliated primary care center (May 2023–December 2025). The primary outcome was adherence to SOS 2023 recommendations. Multivariable logistic regression identified predictors of BMD ordering.

Results: BMD screening was ordered for 19.7% of eligible patients; only 4.1% completed testing. Screening was independently associated with female sex (aOR 5.26), prior osteoporosis (aOR 139.40), prior fracture (aOR 10.35), and female physician sex (aOR 1.50) (all $p<0.05$).

Conclusion: Adherence to universal screening remains low, with a substantial gap between DXA ordering and completion, highlighting important implementation barriers in primary care practice.

Keywords: osteoporosis, bone mineral density, primary health care, guideline adherence, implementation gap, Saudi Arabia

Introduction

Osteoporosis is a skeletal disease that increases an individual's risk of sustaining bone fractures and subsequently increasing morbidity and mortality affecting quality of life. It is a multifactorial disease that cost millions of dollars annually in management due to is sever complications that need intense medical attention.[1,2]

The world health organization first recognized osteoporosis as a separate disease entity in 1994 brining the extremely needed light onto the disease as a serious threat to the general health of the much rising elderly population worldwide.[3] In Saudi Arabia, the first national osteoporosis management guidelines were published by the Saudi osteoporosis society (SOS) in 2015. This document was written by 14 field experts highlighting major management and screening options.[4] After developing the Saudi specific FRAX score tool, these guidelines were updated by the society and released back in 2023.[5]

Internationally, osteoporosis screening recommendations have traditionally followed a risk-based approach. For example, the United States Preventive Services Task Force (USPSTF) recommends routine screening for women aged 65 years and older and for younger women with increased fracture risk, while evidence for routine screening in men remains limited.[6] Similarly, several international bodies, including the International Osteoporosis Foundation, emphasize risk stratification using tools such as FRAX to guide screening decisions.[7] In contrast, the 2023 Saudi Osteoporosis Society (SOS) guidelines adopt a broader public health approach by recommending universal screening for all men and women aged 60 years and above, reflecting the high local disease burden and the need for earlier detection.

Compared with the 2015 Saudi guidelines, which primarily emphasized risk-based screening and clinical judgment, the 2023 update represents a significant paradigm shift toward age-based universal screening. This transition aligns with national preventive health priorities but may present implementation challenges in routine primary care practice, particularly in settings where screening has historically been selective.[4,5]

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The updated guidelines outline the latest recommendations in the field of screening of osteoporosis, management of the disease and prevention of osteoporosis and fragility fractures as well. These guidelines are intended to guide local practitioners from all specialities, including family physicians, dealing with this disease in managing it within the context of the Saudi cultural setting. The updated Saudi osteoporosis management guidelines were indorsed by all the major stakeholders and healthcare governing bodies locally in the kingdom and internationally as well.[5] The Saudi Health Council, the Saudi Rheumatology Society and the Saudi Society of Endocrinology and Metabolism endorsed these guidelines along with the international osteoporosis Foundation.

One of the major screening related updates most relevant in primary care practice in the refined copy of the Saudi guidelines is the recommendation that all Saudi men and women aged 60 years and above should undergo osteoporosis screening using a Dual-energy X-ray absorptiometry (DXA) scan regardless of additional risk factors.5 This solidifies the national efforts for early osteoporosis detection due to the high prevalence of the disease and the financial burden caused by fragility fractures.[8,9]

The purpose of this study is to assess the adherence of family physicians in our single academic primary care centre (family and community medicine centre FCMC) to the 2023 updated practice guideline on osteoporosis screening exploring factors related to physicians, patients and PHC setting that may influence adherence rates and DXA scan ordering.

Methods

Study Design

We conducted a retrospective, chart review study with an analytical component to assess adherence of family physicians to the 2023 Saudi Osteoporosis Society (SOS) guidelines for osteoporosis screening and management. The study also evaluated patient, physician, and setting factors associated with adherence to guideline-recommended bone mineral density (BMD) screening.

Study Setting

The study was conducted at the Family and Community Medicine Center (FCMC) at Imam Abdulrahman Bin Faisal University, an academic primary care center providing comprehensive, continuous care to a large population of patients, including university employees, students, and their families. The center serves as a major training site for family medicine residents and is staffed by consultants and specialists in family medicine, with supervised involvement of residents in clinical care.

Clinical services are delivered through structured outpatient clinics supported by an electronic medical record system. Osteoporosis screening through dual-energy X-ray absorptiometry (DXA) is initiated at the discretion of the treating physician in accordance with clinical guidelines. DXA scans are requested electronically and performed through institutional referral pathways within the affiliated healthcare system.

Study Period and Population

Patients

All patients aged 60 years or older who attended FCMC between May 21, 2023, and December 11, 2025 were eligible. Eligibility for BMD screening was determined according to the SOS 2023 guidelines. Missing data for specific variables were handled using a complete-case approach, whereby patients with missing values for a given variable were excluded from analyses involving that variable. In particular, smoking status had missing data and analyses involving this variable were conducted based on available cases without imputation.

Physicians

All family physicians providing adult care at FCMC during the study period were included, encompassing consultants and specialists.

Data Collection

Data were extracted retrospectively from the electronic medical record (EMR) system using a standardized data abstraction form developed in accordance with SOS 2023 guidelines.

Patient-level variables included age, sex, nationality, multiple comorbidities (defined as the presence of two or more chronic conditions documented in the EMR, including but not limited to diabetes mellitus, hypertension, established cardiovascular disease, and chronic respiratory conditions), smoking status, history of osteoporosis or fracture, BMD ordering, and BMD results (normal, osteopenia, osteoporosis). Physician-level variables included gender, rank (specialist or consultant). The primary outcome was adherence to SOS 2023 osteoporosis screening guidelines, defined as appropriate ordering of BMD screening according to SOS 2023 guidelines. Secondary outcomes included: Associations between adherence and patient characteristics, Associations between adherence and physician factors and, Factors influencing DXA scan ordering behavior.

Statistical Analysis

Continuous variables are presented as mean ± standard deviation, and categorical variables as number (percentage). Comparisons between patients who underwent BMD screening and those who did not were performed using Student's *t*-test for continuous variables and chi-square test for categorical variables.

Multivariable logistic regression was used to identify independent predictors of BMD screening, reporting adjusted odds ratios (ORs) with 95% confidence intervals (CIs). Variables included in the model were patient sex, physician sex, history of osteoporosis, and history of fracture.

All analyses were performed using SPSS version 29.0 (IBM Corp, Armonk, NY), with a two-sided significance level of 0.05.

Results

Patient Characteristics

A total of 2186 patients aged ≥60 years were included in this study (Table 1). The mean age was 68.9 ± 7.9 years. The majority of patients were 60–74 years old (79.0%), female (54.7%), and Saudi nationals (79.6%). Most patients had multiple comorbidities (97.8%), and among those with available data, 21.5% were current smokers (n = 1793).

Table 1 Baseline Characteristics of Patients Aged ≥60 Years at a Family Medicine Center in Saudi Arabia (N = 2186)

Characteristic		No. (%)
Age — mean ± SD, yr		68.9 ± 7.9
Age group — no. (%)	60–74 yr (Youngest-old)	1726 (79.0)
	75–84 yr (Middle-old)	347 (15.9)
	≥85 yr (Oldest-old)	113 (5.2)
Sex — no. (%)	Male	991 (45.3)
	Female	1195 (54.7)
Nationality — no. (%)	Saudi	1739 (79.6)
	Non-Saudi	447 (20.4)
Multiple comorbidities — no. (%)	No	49 (2.2)
	Yes	2137 (97.8)

(*Continued*)

Table 1 (Continued).

Characteristic		No. (%)
Current smoking status — no. (%) *	No	1407 (78.5)
	Yes	386 (21.5)

Notes: Values are presented as number (percentage) unless otherwise indicated. Age is presented as mean ± standard deviation. *Current smoking status was available for 1793 patients; analyses involving smoking status were conducted using available data without imputation.

Bone Mineral Density Screening by DEXA Scan and Results

Overall, BMD screening was ordered ie DXA scan for 430 patients (19.7%) meaning that overall adherence rate to the 2023 SOS universal screening recommendation was 19.7%. However, only 90 patients (4.1% of the total sample; 20.9% of those with an order) completed the DXA scan and had documented results (Table 2). Among patients who completed BMD testing (n = 90), 31.1% had normal BMD, 47.8% had osteopenia, and 21.1% had osteoporosis. The osteoporosis screening pathway and patient flow are illustrated in Figure 1.

Comparison by BMD Screening Status

Patients who underwent BMD screening were more likely to be female (82.3% vs 47.9%; P <0.01) and had a history of osteoporosis (87.0% vs 5.0%; P <0.01) or fracture (13.5% vs 2.7%; P <0.01) compared with unscreened patients (Table 3). There were no significant differences in age, age group, nationality, multiple comorbidities, or smoking status between screened and unscreened patients. Screening was also more likely to be performed by female physicians (61.5% vs 50.3%; P <0.01) and by specialists rather than consultants (48.4% vs 51.6%; P = 0.04).

Factors Associated with BMD Screening

In multivariable logistic regression analysis (Table 4), factors independently associated with BMD screening included female sex of the patient (adjusted OR, 5.26; 95% CI, 3.47–7.98; P <0.001), female physician (adjusted OR, 1.50; 95% CI, 1.03–2.19; P = 0.036), history of osteoporosis (adjusted OR, 139.40; 95% CI, 93.49–207.85; P <0.001), and history of fracture (adjusted OR, 10.35; 95% CI, 5.16–20.77; P <0.001).

Table 2 Bone Mineral Density Screening and Findings Among Patients Aged ≥60 Years

Variable		No. (%)
BMD ordered — no. (%)	No	1756 (80.3)
	Yes	430 (19.7)
BMD completed — no. (%)	No	340 (79.1% of ordered)
	Yes	90 (20.9% of ordered)
BMD result (n = 90) — no. (%)	Normal	28 (31.1)
	Osteopenia	43 (47.8)
	Osteoporosis	19 (21.1)

Notes: Percentages for BMD completion are calculated among patients with a BMD order (n = 430). Percentages for BMD results are calculated among patients who completed the scan (n = 90).
Abbreviation: BMD, bone mineral density.

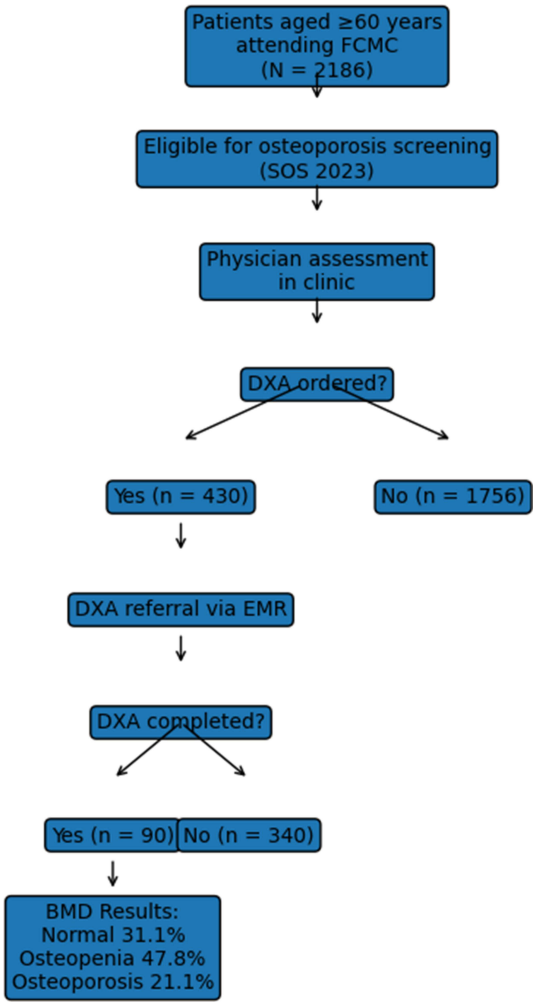

Figure 1 Flowchart illustrating the osteoporosis screening pathway among patients aged ≥60 years in a primary care setting, including physician ordering behavior and completion of dual-energy X-ray absorptiometry (DXA) scans.

Discussion

In the context of Saudi Arabia's national efforts to steer healthcare towards preventive care rather than curative reactive care, the current study reveals crucial challenges in the understanding and implementation of the new osteoporosis screening guidelines into daily PHC practices. Updates encouraged universal screening for all individuals above 60 years rather than risk factors associated screening but notably, DXA was ordered for fewer than one-fifth of eligible patients,

Table 3 Comparison of Patient and Physician Characteristics According to BMD Screening Status

Characteristic		BMD Ordered		*P* value
		No (N = 1756)	Yes (N = 430)	
Age — mean ± SD, yr		68.9 ± 8.1	68.9 ± 7.0	P =0.18
Age group — no. (%)	60–74 yr	1378 (78.5)	348 (80.9)	P = 0.20
	75–84 yr	280 (15.9)	67 (15.6)	
	≥85 yr	98 (5.6)	15 (3.5)	

(*Continued*)

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Table 3 (Continued).

Characteristic		BMD Ordered		*P* value
		No (N = 1756)	Yes (N = 430)	
Sex — no. (%)	Male	915 (52.1)	76 (17.7)	P < 0.01
	Female	841 (47.9)	354 (82.3)	
Nationality — no. (%)	Saudi	1384 (78.8)	355 (82.6)	P = 0.09
	Non-Saudi	372 (21.2)	75 (17.4)	
Multiple comorbidities — no. (%)	No	44 (2.5)	5 (1.2)	P = 0.09
	Yes	1712 (97.5)	425 (98.8)	
Current smoking — no. (%)	No	1126 (78.1)	281 (79.8)	P = 0.49
	Yes	315 (21.9)	71 (20.2)	
Physician sex — no. (%)	Male	865 (49.7)	164 (38.5)	P < 0.01
	Female	874 (50.3)	262 (61.5)	
Physician rank — no. (%)	Specialist	754 (43.0)	208 (48.4)	P = 0.04
	Consultant	1001 (57.0)	222 (51.6)	
History of osteoporosis — no. (%)	No	1669 (95.0)	56 (13.0)	P < 0.01
	Yes	87 (5.0)	374 (87.0)	
History of fracture — no. (%)	No	1709 (97.3)	372 (86.5)	P < 0.01
	Yes	47 (2.7)	58 (13.5)	

Notes: Values are presented as number (percentage) or mean ± standard deviation. Percentages were calculated among patients with available data. P values were calculated using chi-square test for categorical variables and Student's *t*-test for continuous variables. A two-sided P value < 0.05 was considered statistically significant.
Abbreviation: BMD, bone mineral density.

Table 4 Multivariable Logistic Regression for Factors Associated with BMD Screening Among Patients Aged ≥60 Years

Variable	Adjusted OR (95% CI)	P value
Female patient (vs Male)	5.26 (3.47–7.98)	P < 0.001
Female physician (vs Male)	1.50 (1.03–2.19)	P = 0.036
History of osteoporosis (Yes vs No)	139.40 (93.49–207.85)	P < 0.001
History of fracture (Yes vs No)	10.35 (5.16–20.77)	P < 0.001

Notes: Outcome variable: BMD ordered (Yes vs No). Reference categories: male patient, male physician, no history of osteoporosis, no history of fracture. P values were calculated using the Wald test. The regression model was adjusted for patient sex, physician sex, history of osteoporosis, and history of fracture.
Abbreviations: OR, odds ratio; CI, confidence interval.

and only a small proportion completed the test. These findings suggest that dissemination of updated guidance alone may be insufficient to achieve practice change, even in settings supported by electronic medical records and training programs. These numbers were not very different from other data around the Kingdoms especially related to DXA ordering practices within PHC systems.[10] Utilization of DXA scans within tertiary healthcare settings tend to be higher,

evident from the reported medical literature in Saudi Arabia which further confirms the health providers practice patterns of reactive curative care rather than perceiving DXA scans as a primarily preventive tool.[11]

Importantly, the patterns of predictors indicate that physician DXA scan ordering behaviours has not yet shifted from selective, risk factor associated screening to universal aged-based screening. The strong association between documented osteoporosis history and BMD ordering suggests that DXA is predominantly being utilized for confirmation or follow-up of established disease rather than screening. Similarly, the strong association with prior fracture suggests that screening is being prioritized after sentinel clinical events, consistent with a predominantly reactive rather than preventive screening model. These risk factor associated screening patterns have been reported all over where selective screening remains the dominant approach.[12]

Beyond disease-related predictors, notable sex-based differences were observed. Female patients were five times more likely to get a DXA scan order than male patients. This reflects primary healthcare physicians' perception that osteoporosis is a female disease directly influencing who they screen. Such perceptions can contribute to under-recognition and under-screening of osteoporosis among older men, despite the universal guideline recommendation.[13–15] On the physician level, female physicians were more likely to order DXA scans for their patients. Contributors to this fact could be related to female physician's communication styles with their patients and the difference in preventive care delivery.[16] Similarly, the higher likelihood of screening among specialists compared with consultants may reflect differences in clinical training emphasis, workload distribution, or engagement with preventive care practices within the primary care setting.[17,18]

At the health system level, the marked gap between DXA ordering and test completion represents a critical implementation barrier. While nearly one-fifth of eligible patients had a DXA scan ordered, only a small proportion completed the test, highlighting a breakdown in the screening pathway beyond the point of physician decision-making. This "order-to-completion" gap suggests that adherence to guidelines cannot be fully captured by ordering behavior alone and underscores the importance of system-level factors such as appointment availability, referral coordination, patient navigation, and follow-up mechanisms. Addressing this gap will require structured interventions, including closed-loop referral systems, automated patient recall processes, and enhanced care coordination within primary care settings. These barriers are particularly relevant in primary care settings where diagnostic pathways for DXA may depend on referral systems, appointment availability, and coordination across different levels of care.[19–21]

From a population-health perspective, improving adherence to osteoporosis screening programs is crucial as the paradigm shifts in the Saudi population leading to an increase in the geriatric population. With the increase in the estimated life expectancy to reach 79.4 years by 2050, the expected rise in percentages of people living with osteoporosis and are at risk of debilitating and costly fragility fractures makes osteoporosis prevention a Saudi health priority.[22–24]

Conclusion

Adherence to the updated 2023 Saudi Osteoporosis Society screening guidelines remains suboptimal in primary care, with practice patterns continuing to reflect selective, risk-based approaches rather than universal age-based screening. A substantial gap between DXA ordering and completion further highlights key system-level barriers to effective implementation. Addressing these challenges through targeted interventions, including workflow optimization, patient recall systems, and enhanced care coordination, is essential to align clinical practice with national preventive health priorities and the goals of Saudi Vision 2030.

Study Strengths and Limitations

To our knowledge, this is among the first studies evaluating adherence to the updated 2023 SOS universal screening recommendation in an academic primary care setting. The large sample size with real time EMR driven data with the addition of physician and system level factors and the use of multivariable regression models in the analysis contributed to its novelty.

However, some limitations do exist like the single center setting that might prevent generalizability and the lack of ways to determine physician reasoning while ordering the DEXA scans and the possible un-documentation of DEXA scan results done else where outside the system.

Additionally, although the overall sample size was large, the relatively small number of patients who completed DXA testing may limit the precision of estimates in multivariable analyses.

A comparative analysis between patients who completed DXA testing and those who did not may provide additional insight into barriers to completion; however, this was beyond the scope of the current study and warrants future investigation.

Implication for PHC Practice

Major remedial efforts can be recommended to further enhance universal screening for osteoporosis in alignment with the updated guidelines and the nation preventive efforts. These initiatives may include:

- EMR automated alerts for age ≥60 with Standing orders to aid physicians in making value-based care decisions.
- Routine audit and feedback cycles to identify new challenges and follow reform plans.
- Patient reminder systems with important need to know information on osteoporosis.
- Residents and physicians' orientation modules with periodic updated reminders.

Abbreviations

SOS, Saudi Osteoporosis Society; BMD, bone mineral density; EMR, electronic medical record; PHC, primary health care; FCMC, family and community medical center; IAU, Imam Abdulrahman Bin Faisal University; DXA, Dual-energy X-ray absorptiometry.

Data Sharing Statement

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

Ethical Considerations

The study was approved by the Institutional Review Board of Imam Abdulrahman Bin Faisal University (IRB-2026-01-0021). Given the retrospective design and use of anonymized data, the requirement for informed consent was waived. This study was conducted in accordance with the principles of the Declaration of Helsinki.

Author Contributions

The author contributed to data analysis, drafting or revising the article and gave the final approval of the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no conflicts of interest.

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