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Original article

Knowledge, Attitudes, and Practices Regarding Osteoporosis, Barriers to Bone Mineral Density Screening, and Perceptions of Pharmacists' Roles Among Adults in Sabha, Libya: A Cross-Sectional Study

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Abstract
Osteoporosis is an important public health condition that may remain clinically silent until a fragility fracture occurs. This study assessed osteoporosis-related knowledge, attitudes, and preventive practices among adults in Sabha, Libya, and examined perceived barriers to bone mineral density (BMD) screening and perceptions of pharmacists' roles. A descriptive cross-sectional survey was conducted among adults aged 18 years or older between April and August 2024 using convenience sampling. The questionnaire was translated from English into Arabic, reviewed for consistency, and pilot-tested among 20 adults who were excluded from the main study. Of 350 questionnaires distributed, 289 were returned; eight blank questionnaires were excluded, leaving 281 participants for analysis (response rate 80.3%). Women comprised 80.4% of the sample, and 47.0% were aged 18–29 years. The mean knowledge score was 6.90 out of 11, equivalent to 62.8% correct responses, although important item-level gaps were observed, particularly regarding the asymptomatic nature of osteoporosis and selected risk factors. Only 6.0% had previously undergone BMD testing, whereas 80.1% reported willingness to undergo testing if given the opportunity. Commonly reported barriers included lack of awareness of osteoporosis risk (79.7%), limited availability of BMD testing in health centres (63.7%), lack of knowledge about the test (58.0%), and absence of a physician request (53.7%). Participants generally supported pharmacists' involvement: 76.9% agreed that pharmacists could provide medication advice, and 60.5% supported a role for private pharmacies in facilitating BMD testing. The findings show a substantial gap between willingness to be screened and actual screening uptake. Improving public education, access to risk-based BMD screening, and pharmacist-supported counselling and referral may strengthen osteoporosis prevention in Sabha.
Keywords. Bone Mineral Density; Community Pharmacy; Knowledge, Attitudes and Practices; Osteoporosis.

Introduction

Osteoporosis is a systemic skeletal disorder characterised by reduced bone mass and deterioration of bone microarchitecture, resulting in increased bone fragility and susceptibility to fracture [1]. Osteoporotic or fragility fractures, particularly those involving the hip and vertebrae, are associated with substantial morbidity, functional impairment, loss of independence, reduced quality of life, increased healthcare utilisation, and mortality. The burden of fragility fractures is expected to increase further with population ageing, making osteoporosis prevention and early identification an important global public-health priority [2]. Global analyses have also demonstrated a considerable and increasing burden attributable to osteoporosis, low bone mass, and associated fractures across countries and regions [3].

One of the major challenges in osteoporosis prevention is that bone loss can progress without obvious clinical manifestations until a fragility fracture occurs. Consequently, individuals may underestimate their susceptibility to the disease and may not seek preventive assessment while they remain asymptomatic. Identification of individuals at increased fracture risk and appropriate use of bone mineral density (BMD) assessment are therefore important components of osteoporosis prevention. Dual-energy X-ray absorptiometry (DXA) is the principal technique used to measure BMD and forms a central component of osteoporosis screening strategies. Current recommendations support DXA-based screening for women aged 65 years or older and for younger postmenopausal women who have risk factors and are identified as having increased fracture risk using clinical risk assessment [4]. Many risk factors for osteoporosis and fragility fractures are potentially identifiable before a fracture occurs. These include increasing age, postmenopausal status, low body weight, parental or family history of hip fracture or osteoporosis, cigarette smoking, excessive alcohol consumption, physical inactivity, inadequate nutritional intake, and exposure to medications associated with bone loss, particularly long-term systemic corticosteroids [1,4].

Effective prevention therefore depends not only on access to diagnostic services but also on individuals having sufficient knowledge to recognise relevant risk factors and adopt appropriate preventive behaviours. Public knowledge, attitudes, and practices (KAP) are consequently important determinants of osteoporosis prevention and timely screening. Studies from several Middle Eastern populations have demonstrated that awareness of osteoporosis does not necessarily translate into comprehensive knowledge or appropriate preventive behaviour. Among young adults in Riyadh, Mujamammi et al. reported an overall low level of osteoporosis knowledge and identified deficiencies in preventive lifestyle practices [5]. Similarly, an earlier community study in Riyadh found that knowledge and preventive behaviours were suboptimal despite relatively favourable perceptions regarding the benefits of osteoporosis prevention [6]. More recently, Abumunaser et al. found that although 59.1% of adults surveyed in Jeddah demonstrated good overall osteoporosis knowledge, only 10.8% consistently practised a healthy and active lifestyle, illustrating a continuing gap between knowledge and preventive behaviour [7]. A study from southwestern Saudi Arabia similarly identified inconsistencies between osteoporosis-related

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knowledge, attitudes, and preventive practices [8]. These findings highlight the importance of examining knowledge together with attitudes, actual practices, and barriers to screening rather than considering awareness alone. Healthcare professionals have an important role in addressing these gaps.

Although physicians remain central to osteoporosis diagnosis and treatment, pharmacists are among the most accessible healthcare professionals and may have opportunities to contribute to prevention through patient education, medication review, recognition of medication-related risk factors, reinforcement of adherence, identification of individuals who may require further assessment, and referral for appropriate medical evaluation. This role is particularly relevant because patients at risk of osteoporosis may regularly encounter community pharmacists while obtaining prescription or non-prescription medications, even when they have limited interaction with other healthcare services. Evidence suggests that pharmacist-led or pharmacist-supported interventions can improve aspects of osteoporosis care. In a randomised controlled trial, Yuksel et al. found that a multifaceted community pharmacist intervention incorporating risk assessment, education, screening, and referral approximately doubled the proportion of high-risk patients who subsequently received further osteoporosis investigation or treatment compared with usual care [9].

More recently, a systematic review of 12 pharmacist-intervention studies involving more than 16,000 participants concluded that pharmacist interventions showed potential to improve osteoporosis investigation, treatment initiation, treatment adherence, and patient education, while emphasising the importance of collaboration between pharmacists and physicians [10]. Community pharmacies represent an important and frequently used point of healthcare access in Sabha. Previous local studies have documented the public's regular use of community pharmacies and their perceived importance within the healthcare system, although gaps in counselling and service satisfaction have also been reported [11,12]. These findings highlight the potential of community pharmacies as accessible settings for osteoporosis education, risk assessment, medication review, and referral for appropriate screening. However, the ability of pharmacists to contribute effectively may depend partly on public recognition and acceptance of this professional role. Individuals may traditionally rely predominantly on physicians for osteoporosis information while perceiving pharmacists mainly as medication dispensers. Understanding public perceptions of pharmacists' potential involvement in osteoporosis prevention, medication counselling, risk identification, and promotion of appropriate BMD assessment is therefore important before implementing expanded pharmacy-based services.

Evidence concerning osteoporosis knowledge and perceptions in Libya remains comparatively limited. An earlier cross-sectional study among medical, pharmacy, and dentistry students at the University of Tripoli demonstrated acceptable but incomplete osteoporosis knowledge, with important gaps remaining despite the participants being healthcare students [13]. However, findings from university healthcare students cannot necessarily be generalised to the wider adult population. Furthermore, the available evidence provides limited information regarding osteoporosis-related preventive practices, barriers to BMD screening, and public perceptions of pharmacists' potential roles, particularly among residents of southern Libya. This information is important in settings where access to specialised diagnostic services may be constrained and where community pharmacies could potentially contribute to risk identification, health education, and referral. Therefore, this study aimed to assess knowledge, attitudes, and practices regarding osteoporosis among adults residing in Sabha City, southern Libya; identify perceived barriers to bone mineral density screening; determine participants' sources of osteoporosis-related health information; and explore public perceptions of pharmacists' roles in osteoporosis prevention, medication-related care, and promotion of appropriate screening. Understanding these factors may help identify opportunities for targeted public education, improved screening pathways, and greater integration of pharmacists into community-based osteoporosis prevention strategies.

Methods

Study Design and Setting

A descriptive cross-sectional study was conducted in Sabha City, southern Libya, between April and August 2024. The study was designed to assess osteoporosis-related knowledge, attitudes, and preventive practices among adults residing in Sabha, as well as perceived barriers to bone mineral density (BMD) screening, preferred sources of osteoporosis-related health information, and perceptions regarding pharmacists' roles in osteoporosis prevention and management. Sabha is the principal urban centre in southern Libya and serves a geographically dispersed population. The cross-sectional design was selected because it allowed the assessment of participants' knowledge, attitudes, practices, and perceptions at a single point in time.

Study Population and Eligibility Criteria

The target population consisted of adults residing in Sabha City. Individuals were eligible to participate if they:

- were aged 18 years or older
- were residents of Sabha City at the time of data collection
- were able to understand and complete the questionnaire; and
- voluntarily agreed to participate in the study

Individuals younger than 18 years and questionnaires that contained no usable participant data were excluded from the analysis.

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Sampling and Recruitment

A convenience sampling approach was used. Participants were recruited from different locations within Sabha City in an attempt to include adults from different demographic and occupational backgrounds. The study therefore used a non-probability sample, and the findings should be interpreted as reflecting the surveyed population rather than as population-prevalence estimates for all residents of Sabha or Libya.

Study Instrument

Data were collected using a structured, self-administered questionnaire developed with reference to previous studies examining osteoporosis-related knowledge, attitudes, practices, prevention, and screening [5-8,13].

The questionnaire was initially prepared in English and translated into Arabic using Google Translate. The research team subsequently reviewed the Arabic version against the English questionnaire and revised the wording to improve clarity and ensure consistency between the two versions. Formal backward translation was not performed; therefore, equivalence between the English and Arabic versions was assessed by research-team review and pilot testing rather than by an independent forward-backward translation procedure.

Before the main data collection, the Arabic questionnaire was pilot-tested among 20 adults of different ages and both sexes to assess the clarity, comprehensibility, and consistency of the questions. Feedback obtained during pilot testing was used to revise unclear wording and prepare the final questionnaire. Pilot participants were excluded from the main study and were not included in the final analytical sample of 281 participants.

The final questionnaire consisted of seven main sections:

1. Sociodemographic and health characteristics, including age, sex, marital status, educational level, occupation, smoking status, comorbidities, family history of osteoporosis, and previous fracture history.
2. Knowledge about osteoporosis, consisting of 11 items addressing the clinical characteristics, consequences, risk factors, and prevention of osteoporosis.
3. Attitudes toward osteoporosis and its prevention, consisting of eight statements addressing perceived susceptibility, severity, prevention, public education, and BMD screening.
4. Osteoporosis-related preventive practices, consisting of 10 items addressing previous BMD testing, willingness to undergo BMD screening, vitamin D and calcium testing, dietary practices, medication-related practices, and selected lifestyle behaviours.
5. Perceived barriers to BMD screening, including lack of awareness, lack of availability of BMD testing, lack of knowledge about BMD testing, cost, lack of physician requests, difficulty accessing testing facilities, and other barriers.
6. Sources of osteoporosis-related health information, including physicians, pharmacists, internet websites, books or publications, television, and other sources.
7. Perceptions of pharmacists' roles in osteoporosis prevention and management, consisting of five statements addressing medication counselling, identification of individuals at risk of drug-induced osteoporosis, pharmacists' contribution to screening, involvement in prevention and management, and medication review to reduce fracture and fall risk.

The attitude and pharmacist-role items were primarily assessed using three response categories: agree, neutral, and disagree, whereas most practice items used categorical responses such as yes and no.

For analysis of educational level, Academic (code 1) and University (code 2) were grouped as academic/university-level education, while Secondary (code 3) and Elementary (code 4) were grouped as secondary/elementary education.

Data Collection Procedure

Paper questionnaires were distributed directly to eligible participants between April and August 2024. Participants were informed about the purpose of the study and were asked to complete the questionnaire voluntarily. Completed questionnaires were collected by the researchers and subsequently entered into an electronic database for statistical analysis. Participant-identifying information was not included in the analytical dataset.

Data Management and Cleaning

The original electronic dataset contained 289 rows. Before statistical analysis, the dataset was examined for completeness and coding consistency. Eight rows contained no participant data across the study variables and were therefore excluded as completely blank records. The final analytical dataset consequently consisted of 281 participants. All variables were checked against the prespecified coding scheme for completeness and coding consistency. After data cleaning, the 281 analytical records contained valid responses for all variables included in the present analysis; therefore, descriptive percentages and inferential analyses used N = 281 unless otherwise stated. For multiple-response questions, particularly barriers to BMD screening and sources of osteoporosis information, each option was analysed independently. Consequently, percentages within these sections were not expected to sum to 100%.

Measurement of Osteoporosis Knowledge

The knowledge section consisted of 11 items. Each response corresponding to the answer designated as correct in the original study scoring scheme was assigned a score of 1, whereas incorrect and neutral/uncertain responses were assigned a score of 0. For negatively phrased or factually false statements, scoring was reversed so that rejection of the statement

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(disagree/false) received 1 point. Thus, disagreement/false was the correct response to "Previous pelvic fracture is not a risk factor for osteoporosis" and to "Calcium supplements alone can prevent osteoporosis." Individual item scores were summed to generate an overall osteoporosis knowledge score ranging from 0 to 11, with higher scores representing greater osteoporosis-related knowledge. Knowledge findings were reported primarily at the individual-item level as the number and percentage of participants providing correct responses. The total knowledge score was additionally summarised using the mean and standard deviation and the median and interquartile range. Internal consistency of the 11 dichotomously scored knowledge items was assessed using Cronbach's alpha, which is equivalent to the Kuder-Richardson 20 coefficient for binary items under conventional scoring. Because the items represented several distinct aspects of osteoporosis knowledge, item-level findings were emphasised rather than relying exclusively on the composite score.

Assessment of Attitudes and Preventive Practices

Responses to individual attitude statements were reported as frequencies and percentages for agree, neutral, and disagree categories. Preventive-practice variables were primarily analysed individually as categorical variables. Because the practice items represented heterogeneous behaviours rather than a clearly established unidimensional construct, an overall practice score was not used as the primary outcome.

Assessment of Barriers to BMD Screening and Information Sources

Participants could identify more than one perceived barrier to BMD screening and more than one source of osteoporosis-related health information. Each response option was therefore coded and analysed independently. Results were expressed as the number and percentage of participants selecting each option. Percentages were not mutually exclusive and therefore could exceed 100% when summed across response options.

Assessment of Perceptions of Pharmacists' Roles

Five questionnaire items evaluated participants' perceptions of pharmacists' roles in osteoporosis prevention and management. Responses to individual statements were summarised as frequencies and percentages for agree, neutral, and disagree. For exploratory analysis of overall perceptions, the responses were coded as follows: Agree = 3; Neutral = 2; Disagree = 1. Scores from the five items were summed to produce a pharmacist-role perception score ranging from 5 to 15, with higher scores indicating more favourable perceptions of pharmacists' involvement in osteoporosis prevention and management. Internal consistency of the five-item scale was assessed using Cronbach's alpha.

Statistical Analysis

Data were analysed using IBM SPSS Statistics version 23. Categorical variables were summarised using frequencies and percentages. Continuous or composite scores were assessed for their distribution and summarised using the mean and standard deviation (SD) when appropriate and the median and interquartile range (IQR) where useful. Associations between categorical variables were assessed using the Pearson chi-square test. Fisher's exact test was considered where expected cell frequencies were insufficient for the assumptions of the chi-square test. Because composite knowledge and perception scores were treated conservatively as non-normally distributed or ordinal-derived measures, differences between two independent groups were assessed using the Mann–Whitney U test, while comparisons involving three or more independent groups were assessed using the Kruskal–Wallis test. These analyses were used to examine whether osteoporosis knowledge or perceptions of pharmacists' roles differed according to selected participant characteristics such as sex, age group, and educational level. All statistical tests were two-sided, and a p-value <0.05 was considered statistically significant. Results were based on all 281 participants because the final cleaned analytical dataset contained complete, valid responses for the variables included in this analysis.

Ethical Considerations

Participation was voluntary. The study objectives and procedures were explained before questionnaire completion, and informed consent was obtained from all participants. No personally identifying information was included in the analytical dataset, and confidentiality was maintained throughout data collection and analysis. Ethical approval was obtained from the Committee for Research Quality Assurance and Ethics for Undergraduate Students, Faculty of Pharmacy, Sebha University, Libya, on 4 January 2024 (Approval No. 003/2024).

Results

Participant Characteristics

Of the 350 questionnaires distributed, 289 were returned. Eight returned questionnaires contained no usable participant data and were excluded, leaving 281 questionnaires for analysis. The usable response rate was 80.3%. A total of 281 participants were included in the final analysis. As shown in Table 1, nearly half were aged 18–29 years (47.0%), followed by those aged 30–39 years (21.7%), 40–49 years (16.7%), and ≥50 years (14.6%). The majority were female (80.4%) and single (58.4%). Most had academic or university-level education (80.1%). Employees represented the largest occupational group (50.5%), followed by students (31.7%), participants working in private or own businesses (9.6%), other/retired participants (6.0%), and housewives (2.1%). Most participants reported no comorbidities (84.7%). A family history of osteoporosis was

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reported by 17.1%, while 60.9% reported no family history and 22.1% were unsure. Previous fracture was reported by 13.2%, and 8.9% were current smokers.

Table 1. Sociodemographic and clinical characteristics of participants (N = 281)

Characteristic	Category	n (%)
Age group (years)	18–29	132 (47.0)
	30–39	61 (21.7)
	40–49	47 (16.7)
	≥50	41 (14.6)
Sex	Female	226 (80.4)
	Male	55 (19.6)
Marital status	Single	164 (58.4)
	Married	117 (41.6)
Educational level	Academic/university	225 (80.1)
	Secondary/elementary	56 (19.9)
Occupation	Employee	142 (50.5)
	Student	89 (31.7)
	Private/own business	27 (9.6)
	Other/retired	17 (6.0)
	Housewife	6 (2.1)
Comorbidity	Yes	43 (15.3)
	No	238 (84.7)
Family history of osteoporosis	Yes	48 (17.1)
	No	171 (60.9)
	Unsure	62 (22.1)
Previous fracture	Yes	37 (13.2)
	No	244 (86.8)
Current smoking	Yes	25 (8.9)
	No	256 (91.1)

Note: Percentages were calculated using N = 281 and may not total exactly 100% because of rounding.

Osteoporosis Knowledge, Attitudes, and Preventive Practices

As presented in Table 2, participants demonstrated variable levels of knowledge across different aspects of osteoporosis. The highest proportion of correct responses was observed for the association between osteoporosis and increased fracture risk (96.8%), followed by recognition that women are more commonly affected than men (90.4%) and that inadequate calcium intake is a risk factor for osteoporosis (86.1%). Approximately three-quarters of participants (75.4%) correctly identified vitamin D as having a preventive role. In contrast, important knowledge gaps were identified. Only 29.2% correctly recognised that osteoporosis may occur without symptoms, while 35.6% correctly identified family history as a risk factor. Less than half correctly recognised lack of regular exercise (41.6%) and corticosteroid use (43.1%) as factors associated with osteoporosis. The mean knowledge score was 6.90 ± 1.62 out of 11, with a median of 7 (IQR: 6–8).

Internal consistency of the 11-item knowledge score was low (Cronbach's alpha = 0.24); therefore, item-level findings were emphasised. Participants generally demonstrated favourable attitudes toward osteoporosis prevention and screening. More than nine in ten agreed that BMD screening should be available free of charge in primary healthcare settings (91.8%) and that more information and education about osteoporosis prevention should be provided to the public (92.2%). Nearly three-quarters (73.0%) agreed that BMD screening should be routinely considered for older women, and 64.1% recognised that osteoporosis-related fractures can be disabling. However, perceptions of personal susceptibility were less pronounced. Only 42.0% reported concern about developing osteoporosis, and 43.4% believed that their lifestyle might place them at risk of the disease. With regard to preventive practices, only 17 participants (6.0%) had previously undergone BMD measurement. Nevertheless, 225 participants (80.1%) stated that they would undergo a BMD test if given the opportunity. Previous measurement of vitamin D and blood calcium was reported by 69.4% and 63.7% of participants, respectively.

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Table 2. Osteoporosis knowledge, attitudes, and preventive practices among participants (N = 281)

Item	Correct/Agree/Yes, n (%)	Neutral, n (%)	Incorrect/Disagree/ No, n (%)
Knowledge items			
Osteoporosis may occur without symptoms.	82 (29.2)	0 (0.0)	199 (70.8)
Osteoporosis increases the risk of fractures.	272 (96.8)	0 (0.0)	9 (3.2)
Women are more commonly affected by osteoporosis than men.	254 (90.4)	0 (0.0)	27 (9.6)
Previous pelvic fracture is not a risk factor for osteoporosis.	181 (64.4)	0 (0.0)	100 (35.6)
Inadequate intake of calcium-rich foods is a risk factor.	242 (86.1)	1 (0.4)	38 (13.5)
Family history of osteoporosis is a risk factor.	100 (35.6)	0 (0.0)	181 (64.4)
Lack of regular exercise is a risk factor.	117 (41.6)	0 (0.0)	164 (58.4)
Women with early menopause are more susceptible to osteoporosis.	172 (61.2)	0 (0.0)	109 (38.8)
Vitamin D supplementation can reduce osteoporosis risk.	212 (75.4)	0 (0.0)	69 (24.6)
Calcium supplements alone can prevent osteoporosis.	187 (66.5)	0 (0.0)	94 (33.5)
Corticosteroid use may cause osteoporosis.	121 (43.1)	0 (0.0)	160 (56.9)
Attitude items			
I think osteoporosis is incurable.	43 (15.3)	60 (21.4)	178 (63.3)
I am concerned about developing osteoporosis.	118 (42.0)	65 (23.1)	98 (34.9)
My lifestyle may place me at risk of osteoporosis.	122 (43.4)	55 (19.6)	104 (37.0)
BMD screening should routinely be considered for women older than 55 years.	205 (73.0)	53 (18.9)	23 (8.2)
BMD screening should be available free of charge in primary healthcare settings.	258 (91.8)	18 (6.4)	5 (1.8)
Osteoporosis-related fractures can be disabling.	180 (64.1)	64 (22.8)	37 (13.2)
More public information and education about osteoporosis prevention should be provided.	259 (92.2)	14 (5.0)	8 (2.8)
Patients are often unconcerned about their osteoporosis risk.	139 (49.5)	84 (29.9)	58 (20.6)
Preventive-practice items			
Previously underwent BMD measurement.	17 (6.0)	NA	264 (94.0)
Would undergo BMD testing if given the opportunity.	225 (80.1)	NA	56 (19.9)
Previously measured blood vitamin D.	195 (69.4)	NA	86 (30.6)
Previously measured blood calcium.	179 (63.7)	NA	102 (36.3)
Regularly consumes dairy products.	135 (48.0)	NA	146 (52.0)
Consumes three or more cups of coffee or tea daily.	116 (41.3)	NA	165 (58.7)
Takes medication to prevent osteoporosis.	23 (8.2)	NA	258 (91.8)
Usually asks the pharmacist about prescribed medicines that may contribute to osteoporosis.	71 (25.3)	NA	210 (74.7)
Consumes soft drinks with daily meals.	123 (43.8)	NA	158 (56.2)
Believes that lack of appropriate exercise facilities for women undermines osteoporosis prevention.	135 (48.0)	NA	146 (52.0)

Note: Percentages were calculated using N = 281 and may not total exactly 100% because of rounding. BMD, bone mineral density. NA indicates that a neutral response category did not apply to binary preventive-practice items. For knowledge items, the first numeric column reports the number and percentage of participants who gave the correct response, regardless of whether the correct response required agreement or disagreement. Negatively phrased or factually false statements were reverse-scored: disagreement/false was coded as correct for "Previous pelvic fracture is not a risk factor for osteoporosis" and "Calcium supplements alone can prevent osteoporosis." Neutral/unsure responses were scored as 0 in the total knowledge score.

Regarding preventive practices, approximately 48.0% reported regular consumption of dairy products, while 41.3% consumed three or more cups of coffee or tea daily. Only 8.2% reported taking medication for osteoporosis prevention, and 25.3% routinely asked pharmacists about prescribed medications that might contribute to osteoporosis. Daily

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consumption of soft drinks was reported by 43.8%, while 48.0% considered the lack of appropriate exercise facilities for women to negatively affect osteoporosis prevention.

Barriers to BMD Screening and Sources of Osteoporosis Information

Table 3 summarises participants' perceived barriers to BMD screening and their sources of osteoporosis-related health information. The most commonly identified barrier was lack of awareness of osteoporosis risks (79.7%). This was followed by lack of availability of BMD testing in health centres (63.7%), lack of knowledge about the existence of BMD testing (58.0%), and physicians not requesting BMD testing (53.7%). The cost of BMD testing was identified as a barrier by 42.3% of participants, while 23.5% reported difficulty accessing healthcare centres that provided the test. Other reasons were reported by 9.3% of participants.

Table 3. Perceived barriers to BMD screening and sources of osteoporosis information (N = 281)

Domain	Response option	Selected, n (%)
Perceived barriers to BMD screening	Lack of awareness of osteoporosis risks	224 (79.7)
	Lack of BMD testing in health centres	179 (63.7)
	Lack of knowledge that BMD testing exists	163 (58.0)
	Physicians do not request BMD testing	151 (53.7)
	High cost of BMD testing	119 (42.3)
	Difficulty accessing centres that provide BMD testing	66 (23.5)
	Other barriers	26 (9.3)
Sources of osteoporosis information	Physicians	217 (77.2)
	Internet websites	160 (56.9)
	Pharmacists	79 (28.1)
	Books, magazines, and publications	39 (13.9)
	Television	38 (13.5)
	Other sources	19 (6.8)

Note: Multiple responses were permitted; percentages are not mutually exclusive. BMD, bone mineral density.

Regarding sources of osteoporosis-related medical information, physicians were the most frequently reported source (77.2%), followed by internet websites (56.9%). Pharmacists were reported as a source by 28.1%. Less frequently reported sources included books, magazines, and publications (13.9%), television (13.5%), and other sources (6.8%). Because participants were allowed to select more than one barrier and more than one source of information, the percentages within these categories were not mutually exclusive and therefore did not total 100%.

Participants' Perceptions of Pharmacists' Roles in Osteoporosis Prevention and Management

As shown in Table 4, participants generally expressed favourable perceptions regarding pharmacists' involvement in osteoporosis prevention and management. More than three-quarters (76.9%) agreed that pharmacists could provide advice regarding medications used to treat osteoporosis.

Table 4. Participants' perceptions of pharmacists' roles in osteoporosis prevention and management (N = 281)

Statement	Agree, n (%)	Neutral, n (%)	Disagree, n (%)
Pharmacists can advise patients about medications used to treat osteoporosis	216 (76.9)	33 (11.7)	32 (11.4)
Pharmacists can identify individuals at risk of drug-induced osteoporosis	129 (45.9)	66 (23.5)	86 (30.6)
Enabling private pharmacies to contribute to BMD testing can help prevent osteoporosis	170 (60.5)	60 (21.4)	51 (18.1)
Pharmacist interventions in osteoporosis prevention and treatment can have positive outcomes	184 (65.5)	65 (23.1)	32 (11.4)
Pharmacists can reduce fracture and fall risk by reviewing medication regimens	196 (69.8)	57 (20.3)	28 (10.0)

Note: Percentages were calculated using N = 281 and may not total exactly 100% because of rounding.

Agreement was lower regarding pharmacists' ability to identify individuals at risk of drug-induced osteoporosis, with 45.9% agreeing, 23.5% remaining neutral, and 30.6% disagreeing. A majority (60.5%) agreed that enabling private pharmacies to contribute to BMD screening could support osteoporosis prevention. Similarly, 65.5% agreed that pharmacist interventions in osteoporosis prevention and treatment could produce positive outcomes. Almost seven in ten (69.8%) agreed that

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pharmacists could help patients reduce the risk of falls and fractures by reviewing their medication regimens. For the exploratory pharmacist-role perception score, the mean was 12.37 ± 2.36 out of 15, and the median was 13 (IQR: 11–14), indicating generally favourable perceptions. Internal consistency of the five-item scale was moderate (Cronbach's alpha = 0.64). No statistically significant differences were observed according to sex (p = 0.622), age group (p = 0.302), or educational level (p = 0.470). Additional inferential analysis showed a statistically significant association between sex and concern about developing osteoporosis ($\chi^2 = 11.98$, p = 0.0025), with women more frequently expressing concern than men. In contrast, the overall knowledge score did not differ significantly according to sex (p = 0.983), age group (p = 0.470), or educational level (p = 0.265). Overall, the results demonstrate a marked contrast between the very low proportion of participants who had previously undergone BMD screening (6.0%) and the high proportion willing to undergo screening if given the opportunity (80.1%). At the same time, participants reported substantial barriers related to awareness and access and showed generally favourable perceptions regarding a greater role for pharmacists in osteoporosis prevention and management.

Discussion

This study provides insight into osteoporosis-related knowledge, attitudes, and preventive practices among adults in Sabha, southern Libya, while also examining barriers to bone mineral density (BMD) screening and public perceptions of pharmacists' roles in osteoporosis prevention and management. Several important findings emerged. Participants answered, on average, 62.8% of the knowledge items correctly, but substantial gaps existed regarding the asymptomatic nature of osteoporosis and several important risk factors. Attitudes toward osteoporosis education and BMD screening were favourable, but these attitudes were not reflected in actual screening behaviour. Only 6.0% of participants had previously undergone BMD testing, despite 80.1% indicating that they would undergo testing if given the opportunity. Lack of awareness, limited availability of BMD testing, and absence of physician requests were prominent perceived barriers. Finally, although pharmacists were relatively infrequently used as sources of osteoporosis information, participants expressed substantial support for pharmacists assuming a greater role in medication counselling, prevention, identification of medication-related risk, and promotion of appropriate osteoporosis screening. Together, these findings suggest a broader gap between awareness, intention, access to preventive services, and utilisation of available healthcare professionals.

The mean osteoporosis knowledge score was 6.90 out of 11, equivalent to 62.8% correct responses. However, item-level results provide a more informative picture than the aggregate score. Nearly all participants recognised the relationship between osteoporosis and fractures, and a large majority recognised inadequate calcium intake as a risk factor. In contrast, only 29.2% recognised that osteoporosis may be asymptomatic, while knowledge concerning family history, inadequate exercise, and corticosteroid-associated osteoporosis was also limited. Similar variability has been reported in other Middle Eastern populations. Abumunaser et al. found that 59.1% of adults in Jeddah had good overall knowledge, with high recognition of calcium deficiency but lower awareness of less obvious risk factors [7]. Mujamammi et al. reported generally low osteoporosis knowledge among young adults in Riyadh [5], while Tripathi et al. found comparatively favourable general awareness in southwestern Saudi Arabia but persistent deficiencies in preventive practices [8]. These findings indicate that familiarity with osteoporosis does not necessarily imply comprehensive knowledge of its clinical presentation or risk factors. The particularly poor recognition of the asymptomatic nature of osteoporosis is clinically important. Osteoporosis is frequently described as a "silent" condition because substantial skeletal deterioration may occur before a fragility fracture provides the first clinical indication of disease [1].

Failure to recognise this characteristic may reduce an individual's perceived need for screening when symptoms are absent. The finding is therefore particularly relevant when considered alongside the very low observed rate of BMD testing in this study. It is possible that individuals who associate osteoporosis primarily with pain or other obvious symptoms may not consider themselves candidates for preventive assessment before such symptoms develop. Recent evidence from Saudi Arabia similarly indicates limited public understanding of DEXA screening: Almushayti et al. (2025) reported that only 29.2% of surveyed adults had heard of DEXA scanning, and only 38.1% demonstrated good overall knowledge concerning osteoporosis screening [14]. Knowledge of family history, physical inactivity, and corticosteroid exposure was also relatively weak in the present study. This pattern is broadly consistent with findings from other regional research. For example, Abumunaser et al. (2024) reported that 58.6% of adults in Jeddah identified family history as a risk factor [7], a noticeably greater proportion than observed in the Sabha sample. The variation may reflect differences in questionnaire wording, study populations, health-information exposure, or educational campaigns.

Recognition of medication-related osteoporosis is particularly relevant to pharmacy practice because prolonged exposure to medications such as systemic glucocorticoids represents an important opportunity for proactive risk identification. This knowledge gap therefore provides a practical rationale for incorporating medication-related bone-health counselling into pharmacy services. No significant difference in the overall knowledge score was observed according to sex, age group, or educational level. The absence of a sex-related difference is consistent with Mujamammi et al. (2021), who similarly reported no significant difference in osteoporosis knowledge between males and females [5], and with Ramli et al. (2018), who found no significant association between sex and osteoporosis KAP among allied-health students [15]. However, these findings differ from Abumunaser et al. (2024), where sex and educational level were significantly associated with knowledge [7], and from Almushayti et al. (2025), who found significant associations between osteoporosis-screening knowledge and age, sex and occupation [14]. Several methodological and population-related factors may explain these differences. More

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than two-thirds of participants were younger than 40 years, approximately four-fifths were female, and four-fifths had academic or university-level education.

Consequently, the sample had limited demographic variability, particularly in education, which may have reduced the ability to detect associations. Furthermore, osteoporosis questionnaires differ substantially in the number and type of questions included and in their scoring thresholds. Direct comparison of "good," "moderate" or "poor" knowledge categories between studies should therefore be undertaken cautiously. Internal consistency of the 11 knowledge items was low (Cronbach's alpha = 0.24), indicating limited inter-item homogeneity. This may partly reflect the heterogeneous content of the items, which sampled different domains of osteoporosis knowledge, including clinical presentation, consequences, risk factors, and prevention, rather than a single narrow construct. Nevertheless, an alpha of 0.24 substantially limits the reliability of the composite knowledge score. Accordingly, the mean total score and subgroup comparisons based on that score should be interpreted cautiously, and item-specific knowledge gaps and misconceptions are more informative in this study. Participants generally demonstrated favourable attitudes toward osteoporosis awareness and prevention. More than 90% supported greater public education and free availability of BMD screening in primary healthcare settings, while almost three-quarters supported routine BMD screening for older women. Nevertheless, only around two-fifths expressed personal concern about developing osteoporosis or believed that their lifestyle could place them at risk. This combination suggests a potential discrepancy between recognising osteoporosis as an important public-health issue and perceiving oneself as personally susceptible to it.

The relatively young age profile of the sample may partly explain this finding. Younger adults may recognise osteoporosis as a serious condition primarily affecting older people while considering their own immediate risk to be low. A similar knowledge–attitude–practice gap has been repeatedly described. Tripathi et al. (2019) reported appreciable knowledge and generally positive attitudes toward osteoporosis in southwestern Saudi Arabia, while preventive behaviours remained less satisfactory [8]. Ramli et al. (2018) likewise found moderate knowledge and attitudes but poor osteoporosis-related practices [15]. Mujamammi et al. (2021) reported that many young adults recognised the importance of calcium and exercise, yet substantially smaller proportions consistently practised preventive behaviours [5]. Abumunaser et al. (2024) also found that only 10.8% of participants consistently practised a healthy and active lifestyle despite relatively favourable general awareness [7]. These findings support the interpretation that providing information alone is unlikely to be sufficient; osteoporosis-prevention programs need to translate awareness into practical opportunities and sustained behaviour. The strongest finding of the present study was the marked discrepancy between actual BMD screening and willingness to undergo screening. Only 17 participants (6.0%) had previously undergone a BMD test, whereas 80.1% stated that they would undergo testing if given the opportunity. This suggests substantial unmet demand for screening rather than a simple lack of interest.

Comparably low utilisation has been reported elsewhere in the region. Dhayihi et al. (2024) found that only 9.8% of 400 women in Jazan had previously undergone DEXA scanning, while 90.2% had not [16]. More recently, Alshammari (2026) evaluated adults eligible for osteoporosis screening in Saudi primary care and found that although DEXA was ordered for 19.7% of eligible patients, only 4.1% actually completed the examination [17]. These findings are strikingly consistent with the current study and indicate that poor screening uptake can persist even when individuals interact with organised healthcare systems. The reported barriers help explain this gap. Lack of awareness of osteoporosis risk was the most frequently identified barrier, followed by lack of availability of BMD testing, lack of knowledge about the existence of BMD testing, physicians not requesting the test and the cost of screening. Similar barriers have been documented in neighbouring settings. Among women in Jazan who had never undergone DEXA scanning, Dhayihi et al. (2024) found that 46.3% reported that the test had not been recommended by a physician and 44.8% cited lack of awareness [16]. Alzain et al. (2025) similarly identified inadequate physician advice or requests as an important obstacle to osteoporosis screening among perimenopausal women [18]. At a broader regional level, Beshyah et al. (2019) surveyed physicians across the Middle East and North Africa and identified insufficient osteoporosis awareness among both patients and physicians, together with financial barriers, as major obstacles to optimal care [19]. The high proportion reporting limited test availability may be particularly important in the context of Sabha and southern Libya.

Access to specialised diagnostic services may be more limited than in large metropolitan centres, and therefore willingness to undergo screening may not translate into actual testing. The finding that more than half of participants reported that physicians did not request BMD testing suggests that barriers may arise at multiple points in the screening pathway: public awareness, healthcare-provider identification of eligible individuals, referral, physical availability of DXA and affordability. Accordingly, improving public awareness without simultaneously addressing referral pathways and service capacity would probably have limited impact. The strong support for making BMD screening free and accessible in primary healthcare settings further reinforces the apparent importance of structural barriers. However, participants' support for routine screening of women above 55 years should be interpreted as an attitude toward screening rather than evidence that this age threshold is clinically appropriate. Current USPSTF recommendations support osteoporosis screening for women aged 65 years or older and for postmenopausal women younger than 65 years when clinical risk assessment indicates increased fracture risk. Thus, educational interventions should promote risk-appropriate screening rather than indiscriminate BMD testing across the general population [4].

Another noteworthy finding was the difference between BMD testing and other bone-related laboratory testing. Approximately 69% of participants reported having previously measured vitamin D and 64% had measured calcium, whereas only 6% had undergone BMD assessment. This may indicate that vitamin D and calcium testing are considerably

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more familiar or accessible to the local population than osteoporosis-specific screening. Such interest in vitamin D may also reflect its particular visibility as a health issue in Libya. A review by Younis (2024) identified vitamin D deficiency as an important public-health concern across Libya and reported particularly high prevalence estimates in Sabha [20]. However, public familiarity with vitamin D or calcium testing should not be equated with osteoporosis screening; serum vitamin D and calcium measurements do not replace DXA-based assessment when BMD evaluation is clinically indicated. The findings concerning pharmacists are particularly relevant to the second major objective of this study. Only 28.1% identified pharmacists as a source of osteoporosis-related medical information, considerably lower than physicians and internet sources.

Nevertheless, participants expressed much greater support for pharmacists taking an active role in osteoporosis management: 76.9% agreed that pharmacists could advise about osteoporosis medications, 60.5% supported pharmacy involvement in BMD-related screening, 65.5% believed pharmacist interventions could improve osteoporosis prevention and treatment, and 69.8% believed pharmacists could help reduce falls and fractures through medication-regimen review. This discrepancy suggests that pharmacists may currently be underutilised for osteoporosis care despite considerable public acceptance of an expanded role. Evidence from intervention studies supports such a role. In a randomised controlled trial, Yuksel et al. (2010) demonstrated that a multifaceted community-pharmacist osteoporosis intervention involving risk identification, education, quantitative ultrasound assessment and physician referral approximately doubled the proportion of high-risk individuals receiving subsequent BMD testing or osteoporosis treatment compared with usual care (22% vs. 11%) [9]. A systematic review by Laird et al. (2023) subsequently found that pharmacist interventions could improve osteoporosis investigation, treatment initiation and adherence, although intervention heterogeneity and methodological limitations restricted the certainty of some conclusions. Importantly, that review identified patient education and pharmacist–physician collaboration as recurring components of successful interventions [10].

Pharmacist involvement may extend beyond promoting screening. Community pharmacists are well positioned to identify potentially modifiable medication-related risks, particularly chronic exposure to glucocorticoids and medications contributing to falls, counsel patients on calcium and vitamin D intake where appropriate, reinforce adherence to prescribed osteoporosis therapies and refer high-risk individuals for formal medical evaluation. Pharmaceutical-care interventions have also demonstrated benefits among patients with established osteoporosis. Lai et al. (2013), for example, reported that pharmaceutical care improved osteoporosis-related knowledge and some patient-centred outcomes among postmenopausal women receiving osteoporosis therapy [21]. The favourable public perceptions of pharmacists' potential roles observed in the present study are consistent with earlier evidence from Sabha showing that community pharmacies are widely used and socially recognised as important healthcare settings. A previous local study reported that 85% of consumers considered community pharmacies indispensable healthcare facilities [11]. Nevertheless, earlier research also identified limitations in counselling, drug-information provision, and overall consumer satisfaction.

Collectively, these findings suggest that community pharmacies may provide a feasible platform for osteoporosis education, medication-risk assessment, and referral; however, successful implementation would require pharmacist training, structured counselling protocols, adequate privacy, and clear referral pathways [12]. However, the present findings should not be interpreted as evidence that community pharmacies should independently diagnose osteoporosis or substitute pharmacy-based devices for DXA. Evidence supporting pharmacist-led programs has generally involved risk assessment, education, case finding, selected screening methods and referral to physicians or formal BMD services. The most appropriate model for Sabha may therefore be an integrated pathway in which community pharmacists identify individuals with recognised risk factors, review medications associated with bone loss or falls, provide targeted education and refer eligible individuals to physicians or BMD facilities. This would complement rather than replace physician-led diagnosis and formal DXA assessment. Interestingly, perceptions of pharmacists' roles did not differ significantly according to sex, age or educational level in the current analysis. Although these findings should be interpreted cautiously, they suggest that acceptance of pharmacist involvement may be relatively broad rather than confined to a particular demographic subgroup. This could be advantageous when designing community-based interventions because pharmacies are frequently accessible without appointments and interact with adults across a wide range of ages and health conditions.

The fact that only approximately one-quarter of participants currently ask pharmacists about medicines that could contribute to osteoporosis nevertheless illustrates the gap between the potential and current utilisation of pharmacy services. Overall, the findings suggest that osteoporosis prevention in Sabha requires interventions at several levels. Public-health education should emphasise that osteoporosis may develop silently, explain important risk factors such as family history, physical inactivity and prolonged corticosteroid use, and clarify who should undergo BMD screening.

At the healthcare-system level, improving access to DXA and establishing explicit referral pathways are likely to be important, particularly for high-risk individuals. Physicians should remain central to clinical risk assessment and diagnosis, while pharmacists could contribute through risk identification, medication review, counselling, and referral. The combination of high willingness to undergo BMD testing and favourable perceptions of pharmacist participation provides a potentially useful foundation for developing and evaluating pharmacist-supported osteoporosis case-finding and referral programs in southern Libya. Several limitations should be considered when interpreting these findings. The cross-sectional design prevents causal inference, while convenience sampling may limit generalizability beyond the surveyed population in Sabha. The sample was disproportionately female, young and university-educated, and therefore should not be considered demographically representative of the whole Libyan population. Responses were self-reported and may be affected by recall or social-desirability bias. In addition, internal consistency of the 11-item knowledge score was low

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(Cronbach's alpha = 0.24), limiting confidence in the composite score and supporting emphasis on item-level findings. The questionnaire was initially translated into Arabic using Google Translate and subsequently reviewed by the research team and pilot-tested; however, no formal backward translation was performed. Subtle semantic differences between the English and Arabic versions may therefore have remained despite these review steps. The study measured perceptions of pharmacists' potential roles rather than the effectiveness of an actual pharmacist-led intervention. Nevertheless, the study identifies an important combination of knowledge gaps, low utilisation of BMD testing, substantial willingness to be screened and favourable attitudes toward pharmacist involvement that warrants further prospective investigation.

Conclusion

This study identified important gaps in osteoporosis-related knowledge and preventive practices among adults in Sabha, Libya, despite generally positive attitudes toward osteoporosis prevention and screening. Participants showed particularly limited awareness of the asymptomatic nature of osteoporosis and of important risk factors, including family history, physical inactivity, and corticosteroid use. A major finding was the substantial discrepancy between actual and intended use of bone mineral density screening. Although only 6.0% of participants had previously undergone BMD testing, 80.1% expressed willingness to undergo screening if given the opportunity. This suggests that the low uptake of osteoporosis screening is unlikely to be explained solely by lack of interest. Rather, limited awareness, inadequate availability of BMD testing, insufficient knowledge about screening, lack of physician requests, and financial barriers appear to contribute importantly to underutilization. The study also revealed a potentially underused role for pharmacists in osteoporosis prevention and management. Although pharmacists were less frequently reported as sources of osteoporosis-related information than physicians or internet sources, most participants supported pharmacists providing medication counselling, contributing to osteoporosis prevention, reviewing medication regimens to reduce fracture and fall risks, and participating in the promotion of appropriate BMD screening. This indicates considerable public acceptance of greater pharmacist involvement in osteoporosis care. Overall, the findings suggest that improving osteoporosis outcomes in Sabha requires more than increasing public knowledge alone. Strategies should simultaneously strengthen awareness, improve access to risk-appropriate BMD screening, support effective referral pathways, and utilise community pharmacists as accessible healthcare professionals for education, medication-risk assessment, counselling, and referral. Further research is needed to evaluate whether structured pharmacist-supported osteoporosis screening and referral interventions are feasible and effective within the Libyan healthcare setting.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

Strengthen public osteoporosis education.

Community awareness programs should emphasise that osteoporosis may progress without obvious symptoms and should provide clear information about major modifiable and non-modifiable risk factors, particularly physical inactivity, inadequate calcium and vitamin D intake, family history, early menopause, smoking, and prolonged corticosteroid use.

Improve access to BMD screening.

Healthcare authorities should work toward improving the availability of DXA/BMD services in Sabha and other underserved areas of southern Libya, particularly for individuals who meet evidence-based screening or fracture-risk criteria.

Develop clear screening and referral pathways.

Primary healthcare services should establish practical pathways for identifying individuals at increased fracture risk and referring eligible patients for BMD assessment. Screening should be based on age and clinical risk factors rather than indiscriminate population testing.

Increase healthcare-provider involvement in early detection.

Physicians and other healthcare professionals should routinely assess osteoporosis risk factors during relevant clinical encounters and recommend appropriate BMD evaluation for eligible individuals. This may help address the substantial proportion of participants who reported that BMD testing had not been requested by their physicians.

Expand pharmacists' role in osteoporosis prevention.

Community pharmacists should be encouraged and appropriately trained to provide osteoporosis education, identify patients with medication-related risk factors, review long-term use of medications associated with bone loss or falls, reinforce adherence to osteoporosis therapy, and refer high-risk individuals for further medical assessment.

Develop pharmacist-supported case-finding and referral programs.

Pilot programs could be established in community pharmacies in Sabha in which pharmacists use standardised fracture-risk assessment tools and medication reviews to identify individuals who may benefit from physician evaluation or BMD testing. The effectiveness, feasibility, and acceptability of such programs should be formally evaluated before wider implementation.

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Strengthen Collaboration Between Pharmacists And Physicians
Integrated osteoporosis-care models should encourage communication between community pharmacists, physicians, and other healthcare professionals so that screening, referral, pharmacotherapy, lifestyle counselling, and follow-up are coordinated rather than delivered independently.

Improve Affordability of Osteoporosis Screening
Policymakers should consider subsidised screening, public-sector provision, or appropriate insurance coverage for high-risk individuals, particularly where cost represents a barrier to clinically indicated BMD assessment.

Promote Preventive Lifestyle Practices
Public-health initiatives should encourage regular weight-bearing and resistance exercise, adequate dietary calcium and vitamin D, smoking cessation, appropriate sunlight exposure, and reduction of behaviours that may adversely affect bone health. Community initiatives should also consider culturally appropriate opportunities for women to participate in regular physical activity.

Conduct Further Research
Larger multicenter studies involving different regions of Libya and more demographically representative samples are needed to determine whether the findings observed in Sabha are generalizable nationally. Future studies should also evaluate healthcare professionals' knowledge and attitudes toward osteoporosis screening and examine the clinical impact of pharmacist-led or pharmacist-supported osteoporosis prevention programs.

Implications For Practice
The findings support a model in which osteoporosis prevention in Sabha is addressed through coordinated public education, risk-based screening, improved access to diagnostic services, and greater involvement of community pharmacists. Because willingness to undergo BMD testing was high despite very low previous screening, interventions that improve access and referral may have considerable potential to reduce the current osteoporosis screening gap.

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Conflict of Interest
The authors declare no conflicts of interest.

Data Availability Statement
The data that support the findings of this study are available from the corresponding author on reasonable request, subject to ethical and institutional requirements.

Declaration of Generative Ai and Ai-Assisted Technologies
During the preparation of this manuscript, the authors used ChatGPT (OpenAI) as an AI-assisted tool for language editing and to improve the clarity, organisation, and presentation of portions of the manuscript. The authors reviewed, revised, and verified all AI-assisted content and take full responsibility for the scientific content, data, statistical analyses, interpretations, references, conclusions, and final version of the manuscript. ChatGPT was not used to generate study data or to perform the original statistical analyses.

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