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Impact of health beliefs and risk perception on willingness to undergo osteoporosis assessment among perimenopausal and menopausal women in primary care: a descriptive cross-sectional study

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Abstract

Background Osteoporosis holds significant clinical importance as a major risk factor for fractures and the associated consequences of chronic pain, disability, loss of independence, decreased quality of life, and increased mortality. Studies have found varied levels of knowledge, risk perception and health beliefs about osteoporosis. The impact of health beliefs and risk perception on willingness to undergo osteoporosis assessment was not known. This study thus aimed to determine the factors that impact the willingness of peri-menopausal and menopausal women to undergo Bone Mineral Densitometry for osteoporosis assessment.

Methods The study was a descriptive cross-sectional study utilising self-administered questionnaires. Women aged 50 years and above were recruited via convenience sampling from a cluster of public primary care clinics in Singapore. The Osteoporosis Health Belief Scale (OHBS) was modified with permission for local context with good validity and reliability. The modified OHBS had 19 items in five subscales: perceived susceptibility to osteoporosis (risk perception), benefits and barriers to calcium intake, and benefits and barriers to exercise. Logistic regression was used to determine the predictors that impacted willingness to undergo osteoporosis assessment.

Results Of 342 women who participated in the study, the mean age was 62.29 years, most were Chinese (75.3%), married (85.3%) and had secondary education (53.4%). Only 15.2% had a family history of osteoporosis and 10.9% were classified as high risk for osteoporosis. Two-thirds of participants (66.1%) were willing to undergo osteoporosis assessment. Logistic regression found that women of Chinese ethnicity, older age, history of fractures and those with higher risk perception and exercise benefits scores were more likely to be willing to undergo osteoporosis assessment.

Conclusion The study highlighted pertinent sociodemographic and clinical factors as well as risk perception and health beliefs that impacted willingness to undergo osteoporosis assessment. Knowledge of these factors will be

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useful when developing interventions to improve preventive behaviours for osteoporosis and increase uptake of osteoporosis assessment for those at risk.

Keywords Osteoporosis assessment, Health beliefs, Risk perception, Menopausal women

Background

Osteoporosis is a systemic skeletal condition marked by low bone mass and the gradual deterioration of the bone tissue microarchitecture [1]. Individuals with osteoporosis experience increased susceptibility to bone fragility, predisposing them to an increased risk of osteoporotic fractures particularly in the hip, spine, and forearms. These fractures are associated with chronic pain, disability, loss of independence, decreased quality of life, and increased mortality [2]. Given its substantial impact, osteoporosis holds significant clinical importance as a major risk factor for fractures, accounting for over 8.9 million cases worldwide annually [3]. As the global population continues to age worldwide, the incidence of osteoporosis and its associated fractures is expected to surge within the next three decades [4].

Women aged 50 and older face a fourfold higher risk of developing osteoporosis compared to men [5], with a global prevalence of 23.1% in women [6]. Among developed Asia-Pacific countries, the osteoporosis prevalence in women aged 40 and older ranges from 10 to 30%, while the incidence of osteoporotic fractures in adults aged 50 and older ranges from 500 to 1000 per 100,000 person-years [7]. Notably, Singapore reports the highest incidence of hip fractures in Asia, with one out of every three women aged 50 and older being afflicted by osteoporosis [7, 8]. A study assessing the economic burden associated with osteoporosis in Singapore estimated costs of up to S$203.5 million in 2017, with projections indicating an increase to S$437.2 million by 2035 [9].

One of the clinical standards developed by the Asia Pacific Consortium on Osteoporosis (APCO) stated that persons with conditions associated with bone loss and/or increased fracture risk should be proactively identified to undergo assessment of bone health [10]. The Singapore Appropriate Care Guide for osteoporosis identification and management in primary care recommends the use of the Osteoporosis Self-Assessment Tool for Asians (OSTA) to identify risk level in post-menopausal women [11]. A large-scale study in Singapore found that 64% of females above 60 were at risk of osteoporosis as defined by OSTA [12]. However, those at risk do not always undergo bone health assessments such as Bone Mineral Densitometry (BMD). In the United States, where universal osteoporosis screening is recommended for women above 65 and targeted screening for younger women with risk factors, overall screening rates were found to be low: 21.1%, 26.5%, and 12.8% among women aged 50–64, 65–79, and 80 years, respectively [13].

The Health Belief Model (HBM) may be used as a framework to understand women's willingness to undergo osteoporosis assessment. In the framework, perceived susceptibility or risk of developing a disease and modifying factors such as demographic variables, perceived benefits and barriers and cues to action determine likelihood of taking preventive health action [14].

Studies have examined knowledge and risk perception about osteoporosis such as how family history affects risk perception. A Hong Kong study of menopausal and post-menopausal women's (PMW) risk perception towards osteoporosis found that less than half (45%) knew about rapid bone loss in PMW, and three out of four felt they had low chance of osteoporosis [15]. A study in Mexico found that 50.2% of adults were concerned about suffering from osteoporosis; 47.1% considered it likely they would develop it and that family history was significantly associated with this concern [16]. A large scale study of Australian women above 55 found that maternal osteoporosis, presence of comorbidities and low body mass index were associated with higher perceptions of osteoporosis risk [17]. A study among patients admitted to a community hospital in Singapore explored osteoporosis knowledge, but not health beliefs, and found low levels of knowledge, especially among older adults and those with lower education [18]. Another study in Singapore of women aged above 65 found that the top reasons for declining BMD were inadequate knowledge about osteoporosis, misconceptions that lifestyle management was sufficient, and perceived high cost of BMD. All the above studies did not explore how perimenopausal and menopausal women's osteoporosis health beliefs and risk perception impacted their willingness to undergo assessment. In addition, there is limited data on how perceived risk, health beliefs about lifestyle behaviours such as calcium intake and exercise, and sociodemographic variables interact to impact willingness to undergo osteoporosis assessment.

Methods

Aim and hypothesis

The aim was to determine the factors that impact the willingness of peri-menopausal and menopausal women to undergo BMD for osteoporosis assessment. The hypothesis was that personal risk perception of developing osteoporosis and osteoporosis health beliefs on preventive factors such as calcium intake and exercise would impact willingness of perimenopausal and menopausal women to undergo osteoporosis assessment.

Study design

The study was a descriptive cross-sectional study utilising self-administered questionnaires.

Setting and participants

To predict factors that determine participants' willingness to undergo osteoporosis assessment, power analysis for logistic regression was calculated. Based on the work of Peduzzi et al. to determine a sufficient sample size of 16 covariates and 50% of positive cases in the population with 5% incomplete questionnaires, the desired sample size was at least 337 [19]. Women aged 50 years and above were recruited via convenience sampling from a cluster of public primary care clinics in Singapore over a period of 6 months in 2022. Women who were unable to provide consent for participation, such as those with known cognitive impairment, and those with known osteoporosis were excluded from the study.

Ethical considerations

The study was approved by the National Healthcare Group - Domain Specific Review Board (NHG DSRB Ref: 2021/00842). The study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants.

Data collection

Participants were recruited during their scheduled clinic follow-up appointments by their attending healthcare provider on a case encounter basis. Trained study team members proficient in the language of potential participants, which included English, Chinese and Malay, explained the study, obtained informed consent, and issued the questionnaires. Participants literate in English proceeded to complete the questionnaires independently with the study team members being readily available to provide necessary clarifications. Translation support to Chinese or Malay language was provided by study team members to participants who required it.

Data collection tools

I) Demographic and clinical data on participants' age, gender, ethnic group, marital status, educational level, height and weight, chronic conditions (if any), history of falls and fractures, and family history of osteoporosis was collected. The list of chronic conditions was derived from Fortin et al. which was developed to document self-reported chronic conditions in primary care [20]. OSTA score was calculated using age in years minus weight in kilograms (kg), with high risk defined as above 20, medium risk as 0 to 20 and low risk as less than 0 [11].

II) Osteoporosis Health Belief Scale (OHBS) was developed to measure health beliefs associated with osteoporosis [21]. In this study, modifications were made to the original 42-item instrument, selecting five relevant subscales that encompass a total of 19-items for use in the local context. Permission to use and modify the instrument was granted by Dr Phyllis Gendler, one of the original developers. Content validation was done with 15 female volunteers above 50 years old, and thereafter construct validation was done with 78 female volunteers above 50 years old. Content validity (S-CVI/Ave) was 0.75. Exploratory factor analysis was conducted on 20 questions assessing willingness to undergo osteoporosis screening using the principal components method with Varimax rotation. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.701, and Bartlett's test of sphericity was significant ($\chi^2(190) = 906.49$, $p < 0.001$), indicating suitability for factor analysis. Five factors with eigenvalues greater than 1 were extracted, accounting for 69.58% of the total variance. Factor 1 consisted of five items with loadings greater than 0.67, Factor 2 included four items with loadings above 0.71, Factor 3 comprised four items with loadings exceeding 0.55, Factor 4 contained two items with loadings above 0.67, and Factor 5 encompassed four items with loadings greater than 0.68. Internal reliability using Cronbach's alpha was 0.69. The five subscales were perceived susceptibility to osteoporosis (risk perception), benefits and barriers to calcium intake, and benefits and barriers to exercise. Each item was rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The possible scores for the subscales of perceived susceptibility to osteoporosis, exercise benefits, calcium benefits and calcium barriers ranged from 5 to 20. For the exercise barriers subscale, the possible score ranged from 5 to 15. Higher scores indicated higher health belief in the tested subscale.

III) A single question assessed the participant's willingness to undergo osteoporosis assessment.

Data analysis

Raw data collected was entered into Research Electronic Data Capture (REDCap®) [22], where access was limited to the study team members. Statistical Package for the Social Sciences (SPSS) version 28 was used for all analysis. Sociodemographic and clinical data, risk perception, osteoporosis health beliefs and willingness to undergo osteoporosis assessment were analysed using descriptive statistics. Frequencies and percentages were used to describe categorical data while mean and standard deviation were used to describe numerical data. In a

Table 1 Differences in modified OHBS subscale scores by willingness to undergo osteoporosis assessment

OHBS subscale	Willingness to undergo osteoporosis assessment		*p*
	No	Yes	
Risk perception	11.0	12.0	**< 0.001**
Calcium benefits	16.0	16.0	0.455
Calcium barriers	9.0	9.0	0.325
Exercise benefits	15.0	16.0	**< 0.001**
Exercise barriers	9.0	9.0	0.122

non-normal distribution, median and interquartile range were used to describe numerical data. Shapiro-Wilk test was used to examine the normality of the data. Independent T-tests or one-way ANOVA were used to determine differences in modified OHBS subscale scores for sociodemographic and clinical variables. Mann–Whitney U tests or Kruskall-Wallis tests were used when the data did not conform to a normal distribution. Chi-square was used to determine the differences between sociodemographic and clinical characteristics and the willingness to undergo osteoporosis assessment. Logistic regression was used to determine the predictors that impacted willingness to undergo osteoporosis assessment. Statistical significance was set at a p-value of less than 0.05.

Results

A total of 342 women participated in the study. The mean age of participants was 62.29 years (SD = 6.47), and the mean body mass index (BMI) was 24.7 kg/m^2 (SD = 4.56). Participants were mostly Chinese (75.3%) and married (85.3%). A minority of participants had primary education or below (19.4%), while most had secondary (53.4%) and tertiary education (27.3%). Only 6.7% of participants had experienced falls in the past six months, 15.8% had a history of fractures and 15.2% had a family history of osteoporosis. Based on OSTA, 10.9% of participants had high risk for osteoporosis; 44.7% had medium risk for osteoporosis; and 44.4% of them had low risk for osteoporosis. Two-thirds of participants (66.1%) were willing to undergo osteoporosis assessment.

The median scores for each subscale of the modified OHBS were 12.0 (IQR 5.0) for risk perception; 16.0 (IQR 2.0) for exercise benefits; 16.0 (IQR 2.0) for calcium benefits; 9.0 (IQR 3.0) for calcium barriers; and 9.0 (IQR 4.0) for exercise barriers.

The differences in modified OHBS subscale scores for sociodemographic and clinical variables was analysed. Women aged above 65 had significantly higher risk perception scores (Z= -2.326, $p = 0.020$) and perceived calcium benefits scores (Z= -2.666, $p = 0.008$). Those of Chinese ethnicity perceived higher barriers to exercise (Z=-2.256, $p = 0.024$). Women with higher education had higher perceived benefits of calcium (H (2) = 7.931, $p = 0.019$) and exercise (H (2) = 8.209, $p = 0.017$). Women with family history of osteoporosis had significantly higher risk perception scores (Z= -6.799, $p < 0.001$). Women categorized as at high risk of osteoporosis based on OSTA had higher risk perception scores (H (2) = 10.979, $p = 0.004$) and perceived higher calcium benefits (H (2) = 13.509, $p = 0.001$), but also higher calcium barriers (H (2) = 7.313, $p = 0.026$).

Table 2 Differences in sociodemographic and clinical variables by willingness to undergo osteoporosis assessment

Demographic and clinical variables	*n*	Willingness to undergo osteoporosis assessment		*p*
		No	Yes	
Ethnicity	253	75	178	**0.005**
Chinese				
Non-Chinese	84	39	45	
Age	220	82	138	0.067
Below 65	117	32	85	
65 and above				
Marital status	286	100	186	0.495
Married				
Not married	50	15	35	
Educational status	66	24	42	0.349
Primary and below				
Secondary	179	65	114	
Tertiary	93	26	67	
Employment status	193	68	125	0.470
Not employed	143	45	98	
Employed				
History of fall	23	6	17	0.405
Yes				
No	315	109	206	
History of fracture	53	13	40	0.116
Yes				
No	286	102	184	
Family history of osteoporosis	50	10	40	**0.023**
Yes				
No	282	103	179	
OSTA category	143	52	91	0.271
Low risk				
Medium risk	147	51	96	
High risk	36	8	28	

Table 1 shows the differences in modified OHBS subscale scores by willingness to undergo osteoporosis assessment. Women with higher risk perception scores and exercise benefits scores were significantly more likely to be willing to undergo osteoporosis assessment (risk perception Z = -4.629, $p < 0.001$; exercise benefits Z = -3.489, $p < 0.001$). There were no significant differences in willingness or not to undergo osteoporosis assessment for calcium benefits, calcium barriers and exercise barriers.

Table 2 shows the differences between sociodemographic and clinical characteristics by willingness to

undergo osteoporosis assessment. There were significant differences in willingness to undergo assessment only for ethnicity (X^2 (1) = 7.936, p = 0.005) and family history of osteoporosis (X^2 (1) = 5.165, p = 0.023).

Binary logistic regression was used to predict for willingness to undergo osteoporosis assessment. In Model 1, we fitted ethnicity, family history of osteoporosis, risk perception and exercise benefits as predictors and the model was statistically significant in predicting the outcome (chi-square = 41.162, df = 4, p < 0.001). The model accounted for 16.4% of the variability observed in the outcome variable. Chinese had 2.2 times the odds of willingness to undergo osteoporosis assessment than other ethnicities (OR 0.455, p = 0.005, 95%CI 0.262 to 0.791). For every additional increase in risk perception score, the odds of willingness to undergo osteoporosis assessment increased by 22.3% (p < 0.001, 95% CI 1.114 to 1.343). The odds of willingness to undergo osteoporosis assessment also increased by 19.4% for every additional increase in exercise benefits score (p = 0.004, 95% CI 1.060 to 1.346).

In Model 2, we fitted 15 variables (ethnicity, age, marital status, educational level, employment status, BMI, history of falls, history of fractures, OSTA category, family history of osteoporosis, risk perception, exercise benefits, exercise barriers, calcium benefits, and calcium barriers) as predictors and the model was statistically significant (chi-square 58.444, df = 17, p < 0.001) and able to account for 24.6% of the total variances. Chinese had 2.18 times the odds of willingness to undergo osteoporosis assessment than other ethnicities (OR 0.457, p = 0.016, 95%CI 0.241 to 0.866). Women with history of fractures were 2.66 times the odds of willing to undergo screening than those with no history of fractures (OR 2.660, p = 0.020, 95% CI 1.165 to 6.074). An additional increase in age increased the willingness to undergo osteoporosis assessment by 7.6% (p = 0.019, 95% CI 1.012 to 1.1431). For every additional increase in risk perception score, the odds of willingness to undergo osteoporosis assessment increased by 26.2% (p < 0.001, 95% CI 1.133 to 1.4061). The odds of willingness to undergo screening also increased by 26.9% for every additional increase in exercise benefit score (p = 0.002, 95% CI 1.094 to 1.473). The logistic regression model is shown in Table 3.

Table 3 Logistic regression model of predictors of willingness to undergo osteoporosis assessment

Variables	Willingness to undergo osteoporosis assessment		
	Exp(B)	Sig	95% CI for EXP (B)
Ethnicity			
Chinese	**Reference**		
Non-Chinese	0.457	**0.016**	0.241–0.866
Marital Status			
Married	**Reference**		
Not married	1.576	0.274	0.698–3.559
Educational Status			
Primary and below	**Reference**		
Secondary	0.788	0.522	0.381–1.633
Tertiary	1.315	0.539	0.548–3.155
Employment status	**Reference**	0.055	0.987–3.319
Not employed	1.810		
Employed			
Age	1.076	**0.019**	1.012–1.143
BMI	0.970	0.301	0.916–1.027
History of fall			
No	**Reference**		
Yes	1.038	0.950	0.322–3.340
History of fracture			
No	**Reference**		
Yes	2.660	**0.020**	1.165–6.074
Family history of osteoporosis			
No	**Reference**		
Yes	1.065	0.890	0.432–2.628
OSTA category			
Low risk	**Reference**		
Medium risk	0.476	0.056	0.222–1.018
High risk	0.517	0.354	0.128–2.089
OHBS subscale scores	1.262	**< 0.001**	1.133–1.406
Risk perception			
Calcium benefit	0.950	0.486	0.823–1.097
Calcium barriers	0.988	0.863	0.867–1.127
Exercise benefit	1.269	**0.002**	1.094–1.473
Exercise barriers	0.897	0.085	0.794–1.015

Discussion

The aim of the study was to determine the factors that impact the willingness of perimenopausal and menopausal women to undergo osteoporosis assessment. Overall, our study found that women with history of fractures, Chinese ethnicity, older age, and those who had higher risk perception score and higher exercise benefits score were more likely to be willing to undergo osteoporosis assessment.

Impact of demographic and clinical factors on risk perception, health beliefs and osteoporosis assessment

The study found that Chinese ethnicity were more likely to be willing to undergo osteoporosis assessment as compared to other ethnic groups. This may be attributed to the fact that Chinese women in Singapore had a 40% higher hip fracture rate compared to Malay women and a striking 90% higher hip fracture rate compared to Indian women [23]. The higher hip fracture rate may have raised awareness and prompted a greater sense of susceptibility to osteoporosis among Chinese women, leading to an increased willingness to undergo osteoporosis assessment as a measure for early detection and prevention. These findings reinforce the importance of culturally

targeted educational interventions to address the specific health concerns of distinct ethnic groups within a population which was also mentioned in prior studies [24].

The study found that women above 65 had higher osteoporosis risk perception scores and higher perceived calcium benefits scores. The findings were consistent with a recent study conducted in Saudi Arabia that found a significant association between age and engagement in osteoporosis preventive behaviors [25]. A study in Poland also demonstrated that women of older age had higher perceived susceptibility of developing osteoporosis, although there were no significant differences found in their perceived benefits of preventive behaviors [26]. Age was also a predictor of willingness to undergo osteoporosis assessment. This was similar to a study conducted in Korea which revealed that older women were more likely to seek osteoporosis assessment [27]. Our findings that older women have higher perceived benefits of calcium, higher perceived risk and greater willingness to undergo assessment holds promise for osteoporosis prevention, assessment and early intervention.

The study demonstrated that women with a history of fractures were more likely to be willing to undergo osteoporosis assessment. Additionally, women who were categorised as high risk for osteoporosis based on OSTA had higher risk perception scores and perceived calcium benefits scores. The findings reflect an appropriate level of awareness regarding risk perception and preventive measures for osteoporosis. This was in contrast to a study conducted in the United States, where less than half of those who had a previous fracture perceived themselves at risk for subsequent fractures and had undergone osteoporosis assessment [28]. A possible reason could be variations in public education about osteoporosis. In Singapore, advocate groups such as the Osteoporosis Society of Singapore [29] may have contributed to the heightened awareness of both risk and preventive measures for osteoporosis. However, there were no significant differences in willingness to undergo osteoporosis assessment among women at high risk based on OSTA, nor was the OSTA risk category a significant predictor for osteoporosis assessment. The findings highlight the need for continued education and awareness campaigns to promote osteoporosis assessment, particularly emphasising the use of OSTA as a tool for screening and assessing risk for osteoporosis.

Family history of osteoporosis was not a statistically significant predictor in both regression models for the willingness to undergo osteoporosis assessment. However, in bivariate analysis, women with family history of osteoporosis had higher risk perception scores and more were willing to undergo osteoporosis assessment. This was in accordance with other studies conducted in Mexico [16], Australia [17] and United States [30] which showed that family history increased perceived susceptibility to osteoporosis. The findings suggest that while a family history of osteoporosis might influence risk perception of osteoporosis, it may not be a major determinant of their proactive health-seeking behaviour to undergo osteoporosis assessment. Other factors such as health beliefs or cultural influences, may play a more substantial role in determining the willingness to undergo osteoporosis assessment. Consequently, healthcare providers may consider leveraging this increased risk perception as a potential avenue for promoting osteoporosis assessment and prevention among at risk women with a family history of the condition.

Impact of risk perception and health beliefs on osteoporosis assessment

The study found that those with higher risk perception scores were more likely to be willing to undergo osteoporosis assessment. This aligns with the HBM which focuses on perceptions to explain their preventive behaviours. The HBM postulates that individuals are more likely to take health related actions, such as seeking assessment, when they perceive themselves to be at higher risk of a particular health condition [14]. In this context, women with elevated risk perception scores may interpret their increased susceptibility to osteoporosis as a serious health threat. As a result, they are more inclined to engage in preventive behaviours like undergoing osteoporosis assessment to reduce this perceived risk and protect their health. This finding underscores the relevance of the HBM in understanding and predicting health related decision making, particularly in the context of osteoporosis prevention. Perceived seriousness of osteoporosis may also impact willingness for osteoporosis assessment. This was not covered in this study as the focus was on perceived risk and preventive health beliefs. A study on a population-based screening program found that women who declined screening had lower self-perceived fracture risk [31]. On the other hand, a study in postmenopausal breast cancer survivors did not find an association between receipt of bone density scan and osteoporosis health beliefs [32].

The study further reflected that those with higher exercise benefits score were more likely to be willing to undergo osteoporosis assessment. The findings were consistent with a study conducted in Saudi Arabia that stated that those with higher exercise benefits score were more likely to practice osteoporosis preventive behaviors [25]. This is in line with the concept of perceived benefits in the HBM where individuals are more inclined to engage in health-related actions when they perceive to have clear benefits [14]. In this context, women with higher exercise benefits scores are likely to recognise the positive impact of regular physical activity on their bone

health and overall well-being. They may view exercise as a valuable preventive measure for osteoporosis, increasing their motivation to seek assessment as part of their health plan.

Strengths and limitations

The study should be interpreted within the context of its strengths and limitations. Firstly, to our knowledge, this is the first study providing insights into the impact of health belief and risk perception on the willingness to undergo osteoporosis assessment in the Singapore context. Secondly, the desired sample size was achieved, ensuring statistical power to determine the factors impacting the willingness to undergo osteoporosis assessment. However, as the study adopted a cross-sectional design, casual inferences about the association between willingness to undergo osteoporosis assessment and its related factors cannot be established. Additionally, participants were recruited using convenience sampling which may not have been representative of the whole population, limiting the generalisability of findings. Also, as the questionnaire was self-administered, there may have been recall bias. Lastly, the study did not assess participants' perceived seriousness of osteoporosis or their beliefs about osteoporosis treatment as the focus was on perceived risk and preventive health beliefs. Further research including beliefs about perceived seriousness of osteoporosis and its association with osteoporosis assessment should be conducted. Beliefs about perceived susceptibility to fractures; and beliefs about efficacy of osteoporosis treatment have also been found to impact treatment initiation and adherence [33]. Information on some aspects of socioeconomic status such as household income was also not collected. Future research may consider exploring the impact of these beliefs and socioeconomic status on willingness to initiate and adhere to osteoporosis treatment.

Conclusion

The study highlighted pertinent sociodemographic and clinical factors as well as risk perception and health beliefs that impacted willingness to undergo osteoporosis assessment. Knowledge of these factors will be useful when developing interventions to improve preventive behaviours for osteoporosis and increase uptake of osteoporosis assessment for those at risk.

Abbreviations

BMD	Bone Mineral Densitometry
BMI	Body Mass Index
HBM	Health Belief Model
OHBS	Osteoporosis Health Belief Scale
OSTA	Osteoporosis Self-Assessment Tool for Asians
PMW	postmenopausal women

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12875-025-02847-5.

Supplementary Material 1

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Author contributions

GLJ analysed and interpreted the data. DRJ and KHM were major contributors in writing the manuscript. All authors read and approved the final manuscript.

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Data availability

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

Declarations

Ethics approval and consent to participate

The study was approved by the National Healthcare Group - Domain Specific Review Board (NHG DSRB Ref: 2021/00842). The study was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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