Physicians' Knowledge, Attitudes and Practices on the Diagnosis and Management of Osteoporosis in a Tertiary Hospital in Manila

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ABSTRACT

Osteoporosis is a major public health concern leading to significant morbidity and mortality, especially in the elderly population. However, this disease is underdiagnosed and, as a result, undertreated. This cross-sectional study aims to determine the knowledge, attitudes and practices (KAP) of physicians in the diagnosis and management of osteoporosis, which would help identify key areas of improvement in the care of patients with this disease. One hundred and nine physicians answered an online questionnaire looking at their KAP on the diagnosis and management of osteoporosis, and their answers were analyzed using descriptive statistics, Pearson's correlation and the Chi-square test. More than half of the participants obtained satisfactory scores on knowledge, and majority had neutral to positive attitude regarding osteoporosis. A statistically significant correlation was seen between having low knowledge and negative attitudes on osteoporosis screening and management.

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INTRODUCTION

Osteoporosis is the most common bone disease in humans[1] and is secondary to an imbalance between bone formation and bone resorption, leading to low bone mass and microarchitectural deterioration of bone tissue. This causes enhanced bone fragility and a consequent increase in fracture risk.[2]

It is a major public health concern, as osteoporotic-related fractures are a major cause of chronic pain, disability and death. Hip fractures are associated with a 15% to 20% increased mortality rate within one year and increased requirement for long-term nursing homecare, decreased quality of life, social isolation, depression and loss of self-esteem.[1]

Almost 20% of the global population suffers from osteoporosis, including 23.1% of women and 11.7% of men.[3] In a local study in an urban community in Davao, Philippines, the prevalence of osteoporosis was 19.8% in postmenopausal women.[4]

Major risk factors for the development of osteoporosis include non-modifiable risk factors such as gender and age, and modifiable risk factors

such as cigarette smoking, poor nutrition and alcohol consumption. Secondary osteoporosis can also be caused by other disease conditions such as hyperparathyroidism, diabetes and the intake of medications such as corticosteroids.[5]

The gold standard for the diagnosis of osteoporosis and prediction of fracture risk is the Dual Energy X-Ray Absorptiometry Scan.[6] Screening instruments such as the Fracture Risk Assessment Tool are also being used. In the local setting, the Osteoporosis Screening Tool for Asians can be used to identify the risk of osteoporosis among postmenopausal women based on their age and body weight.

In spite of significant morbidity in these patients, osteoporosis is underdiagnosed. In a study published in the American Journal of Public Health involving 2314 postmenopausal women, only 5% were told that they had osteoporosis by their primary care physicians. Appropriate drug treatment, including antiresorptive agents, calcium and vitamin D, was offered to only 36% of the diagnosed patients.[7]

A recent study in Malaysia looked at the knowledge, skills and attitudes of primary care physicians on the screening and management of osteoporosis. Of the 350 primary care doctors included in the study, only 110 (31.4%) achieved satisfactory overall knowledge scores of >60% and only 97 (27.7%) routinely practiced osteoporosis screening. The study also identified perceived barriers to osteoporosis screening and management with the inaccessibility of bone mineral density as the most commonly cited reason. Other barriers include inadequate knowledge, coexisting medical conditions that are of a higher priority and inaccessibility of pharmacotherapy at primary care clinics.[8] Similar results were seen in a similar study done in Israel, with only 19% of participants correctly answering questions for treatment initiation in osteoporosis and only 8% being able to answer questions on diagnostic tests and clinical risk factors for osteoporosis.[9]

As of now, no studies of this nature have been done in the Philippines. Hence, this study aims to identify the knowledge, skills and attitudes of physicians who encounter patients with and are at risk for osteoporosis in their practice. In doing so, this study aims to identify gaps which could be addressed to improve patient care. This study will include residents, fellows and consultants from the Sections of Internal Medicine, Family Medicine, Orthopedics and Obstetrics and Gynecology in the University of Santo Tomas Hospital using an online-based questionnaire.

METHODOLOGY

Research Design

This study utilized an observational cross-sectional design. Quantitative data collected through a survey questionnaire will be used to determine the respondents' KAP on osteoporosis screening and management.

Subjects

The research made use of purposive sampling and 109 eligible respondents participated in the study. This yielded 80% power and 5% level of significance calculated using Open Epi software (See Figure 1)

The criteria for inclusion were residents, fellows and consultants from the departments of Internal Medicine, Family Medicine, Orthopedic Surgery, and Obstetrics and Gynecology. These departments were chosen because they include physicians who frequently encounter patients with and who are at risk for osteoporosis in their practice. Those who did not fall within these criteria were excluded from the study.

Data Measure/Instrumentation

This study was conducted at the University of Santo Tomas Hospital, a tertiary hospital in Manila, Philippines. The researchers utilized a self-administered online questionnaire in Google Forms that was adapted with permission from the study of Chai Li Tay, et al., titled "Screening and Management of Osteoporosis: A Survey of Knowledge, Attitudes, and Practices among Primary Care Physicians in Malaysia" published in the Archives of Osteoporosis in 2022[10] which was, in turn, adapted from a similar study done in Israel.[11]

The questionnaire underwent face and content validation as well as pilot testing in the original study and consisted of four sections: demographic information, osteoporosis knowledge, attitude towards osteoporosis as a health issue and practices on osteoporosis screening and management.

Sample Size for Frequency in a Population

Population size(for finite population correction factor or fpc)(*N*):	300
Hypothesized % frequency of outcome factor in the population (*p*):	50.46%+/-5
Confidence limits as % of 100(absolute +/- %)(*d*):	5%
Design effect (for cluster surveys-*DEFF*):	1

Sample Size(*n*) for Various Confidence Levels

ConfidenceLevel(%)	Sample Size
95%	169
80%	107
90%	143
97%	184
99%	207
99.9%	236
99.99%	251

Figure 1 Sample Size Calculation

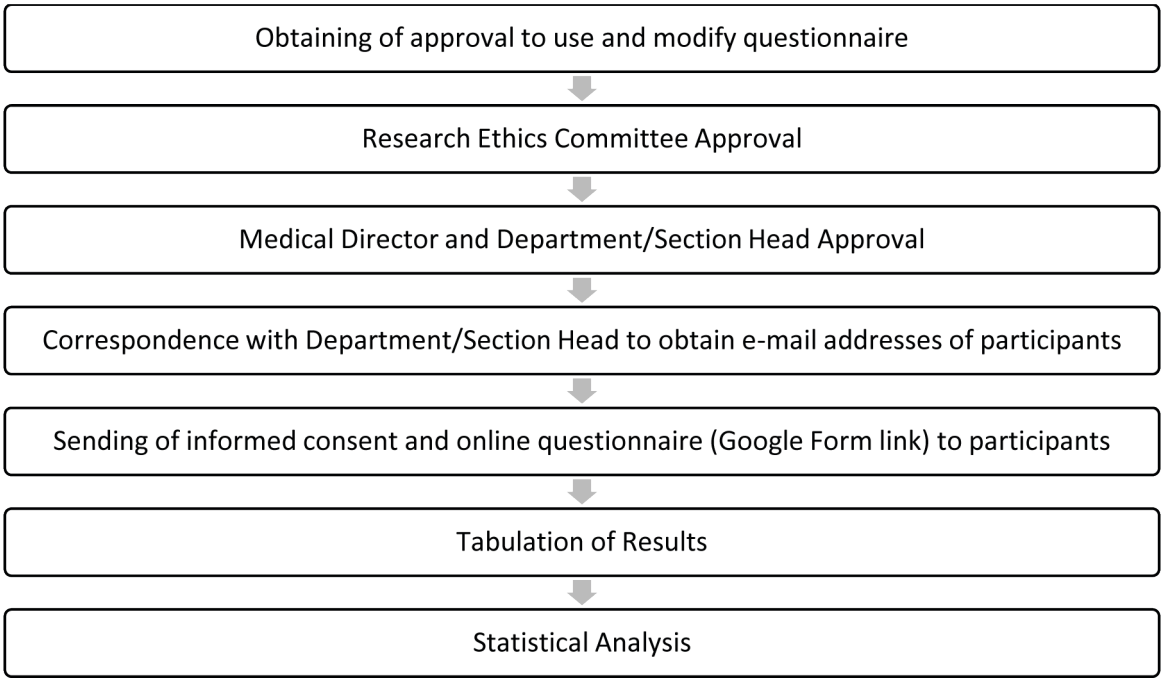

Figure 2 Flowchart of the Study

Data Gathering Procedure

The flowchart for the data gathering procedure is presented in Figure 2. The principal investigator corresponded with the Medical Director to allow the investigator to distribute the questionnaires to different Section Heads of the population to be included in the study. The researcher also collaborated with the different Section Heads to obtain the e-mail addresses of participants. Thereafter, the Google form link for the informed consent form and online questionnaire was sent to the participants. The test questionnaire can be found in the appendix section (see Appendix A). The collated data was tabulated, processed and subjected to statistical analysis.

Ethical Considerations

Ethics approval was obtained from the Research Ethics Committee of the University of Santo Tomas Hospital. All procedures were done in observance of the 2017 National Ethical Guidelines for Health and Health-Related Research and informed consent was sought from all participants.

Data Analysis

Statistical analyses were conducted using the STATA Statistical Software, Version 13, College Station, TX: StataCorp LP. A p value of 0.05 was considered statistically significant. Descriptive statistics included mean and standard deviation for continuous-level data, median and interquartile range for ordinal data, and frequency and proportion for nominal data.[12] The knowledge scores were categorized as unsatisfactory (correct responses <60%) and satisfactory (correct responses ≥60%).[8] In contrast, attitude score was computed by initially summating the responses in all items and categorizing the scores using the quartile and tercile scores.[13,14] Scores below the 33rd percentile of the dataset were classified as negative attitude, scores between the 33rd and 67th percentile were considered neutral attitude and those greater than the 67th percentile were categorized as positive attitude. Comparative analyses of KAP according to designation (trainee versus consultant) were conducted using the Chi-Square Test of Homogeneity or Fisher's Exact test for categorical variables and independent *t*-test for continuous-level variables.[15] The association of overall mean knowledge, represented by the mean percentage correct responses, with attitude score was estimated using Pearson's Correlation, while the association of the proportion of attitude level (negative, neutral and positive attitude) and knowledge level (satisfactory and unsatisfactory) were analyzed using the Chi-Square Test of Independence.[15]

RESULTS

A total of 107 respondents participated in the study.

Table 1 illustrates the demographic characteristics of participants. Results showed that the median age of the participants was 32 years old (IQR = 30 to 36), and majority were female (53.21%) and trainees (70.64%).

Knowledge on Osteoporosis

The descriptive statistics and comparative analyses of the knowledge items and percentage correct responses according to designation are presented in Table 2. It can be noted that the overall knowledge score, in

Table 1 Demographic Characteristics of Participants (n=109)

Characteristics	Frequency	Percentage	Median (IQR)
Age (Years)			32 (30 – 36)
Sex			
Male	49	44.95%	
Female	58	53.21%	
Prefer Not to Say	2	1.83%	
Designation			
Trainee	77	70.64%	
Consultant	32	29.36%	

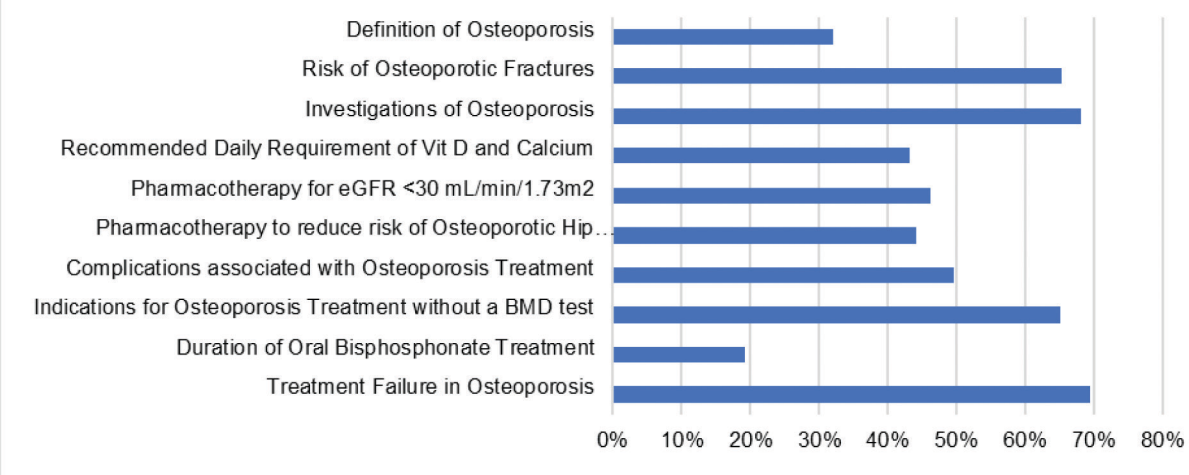

Figure 2 Knowledge on Osteoporosis

Table 2 Descriptive Statistics and Comparative Analysis of Knowledge of Osteoporosis According to Designation

Item	Question	Percentage Correct Answers			*p*-value
		Trainees	Consultants	Total	
1	Definition of Osteoporosis	35.06%	25.00%	32.11%	0.310
2	Risk Factors of Osteoporosis	66.34%	62.50%	65.21%	0.127
3	Investigations for Osteoporosis	68.94%	65.89%	68.04%	0.350
4	Recommended Daily Requirement of Calcium and Vitamin D	46.75%	34.38%	43.12%	0.239
5	Medications for Osteoporotic persons with eGFR <30 mL/min/1.73m^2	46.75%	44.79%	46.18%	0.771
6	Pharmacotherapeutics to Reduce Osteoporotic Hip Fracture Risk	46.32%	38.54%	44.04%	0.074
7	Complications of Osteoporotic Treatment	53.06%	41.07%	49.54%	0.033
8	Patients Requiring Treatment without Confirmatory Test	65.91%	63.28%	65.14%	0.656
9	Maximum Duration of Oral Bisphosphonate Treatment	23.38%	9.38%	19.27%	0.093
10	Treatment Failure of Osteoporosis	69.35%	69.38%	69.36%	0.997
Overall Knowledge		59.43%	54.49%	69.36%	0.997
Overall Knowledge Categories					
Unsatisfactory (Correct Responses <60%)		37.66%	50.00%	41.28%	
Satisfactory (Correct Responses ≥60%)		62.34%	50.00%	58.72%	

terms of percentage correct responses, was 57.98% (SD=12.98), which were not statistically significant (p = 0.068) between trainees ($\bar{x}$=59.43, SD=12.11) and consultants ($\bar{x}$=54.49, SD=14.18). It can also be noted that more than half of the participants had satisfactory knowledge (58.72%) and 41.28% had unsatisfactory knowledge. Comparative analyses of the proportion of satisfactory and unsatisfactory knowledge were not statistically different between trainees and consultants (p = 0.233).

Item analyses showed that among the different items of knowledge, the items commonly answered correct were treatment failure of osteoporosis ($\bar{x}$=69.36%, SD=32.84), laboratory tests for osteoporosis ($\bar{x}$=68.04%, SD=15.45), risk factors of osteoporosis ($\bar{x}$=65.21%, SD=11.94) and patients requiring treatment without confirmatory tests ($\bar{x}$=65.14%, SD=27.85). The least correctly answered item was the maximum duration of oral biphosphate treatment ($\bar{x}$=19.27%, SD=39.62). Comparative analyses of the mean percentage correct responses according to designation, as illustrated in Table 2 and Figure 1, showed that none of the items were significantly different between trainees and consultants (p>0.05), except for item 7 (complications of osteoporosis treatment). In particular, results showed that the mean percentage correct scores of trainees ($\bar{x}$=53.06%, SD=27.01) were significantly higher (p = 0.033) than the consultants ($\bar{x}$=41.07%, SD=24.81). Item analyses for each sub-item can be found in Appendix B.

Attitudes on Osteoporosis

Table 3 depicts the descriptive statistics and comparative analyses of the attitudes on osteoporosis according to designation among the participants. By and large, the mean overall attitude score of the participants was 29.23 (SD=4.15) and were not statistically different (p = 0.305) between trainees ($\bar{x}$=29.49, SD=4.10) and consultants ($\bar{x}$=28.59, SD=4.26). It can also be noted that most participants had neutral attitude (38.53%) and the proportions of negative, neutral and positive attitude were not statistically different between trainees and consultants (p = 0.351).

Among the different attitude items, the item with the highest mean attitude score was item 1 (*osteoporosis is an important health issue*; $\bar{x}$=4.94, SD=0.25), followed by item 2 (*osteoporosis screening is beneficial for patients ≥65 years old*; $\bar{x}$=4.87, SD=0.41) and item 3 (*BMD assessment should be made easily accessible to primary care doctors*; $\bar{x}$=4.85, SD=0.38). In a similar vein, majority of the participants had positive attitudes towards item 1 (100.00%), item 2 (99.08%), item 3 (99.08%) and item 5 (77.06%). Comparative analyses according to designation also indicated that the mean attitude

Table 3 Descriptive Statistics and Comparative Analyses of Attitudes on Osteoporosis According to Designation

Characteristics	Trainees	Consultants	Total	p value
Osteoporosis is an important health issue.	4.94 (0.25)	4.94 (0.25)	4.94 (0.25)	0.963
Negative Attitude	0 (0.00%)	0 (0.00%)	0 (0.00%)	–
Neutral Attitude	0 (0.00%)	0 (0.00%)	0 (0.00%)	
Positive Attitude	77 (100.00%)	32 (100.00%)	109 (100.00%)	
Osteoporosis screening is beneficial for patients who are ≥65 years.	4.90 (0.31)	4.81 (0.59)	4.87 (0.41)	0.335
Negative Attitude	0 (0.00%)	1 (3.13%)	1 (0.92%)	0.294
Neutral Attitude	0 (0.00%)	0 (0.00%)	0 (0.00%)	
Positive Attitude	77 (100.00%)	31 (96.88%)	108 (99.08%)	
BMD assessment should be made easily accessible to primary care doctors.	4.86 (0.39)	4.84 (0.37)	4.85 (0.38)	0.868
Negative Attitude	0 (0.00%)	0 (0.00%)	0 (0.00%)	1.000
Neutral Attitude	1 (1.30%)	0 (0.00%)	1 (0.92%)	
Positive Attitude	76 (98.70%)	32 (100.00%)	108 (99.08%)	
I am confident in BMD result interpretation.	3.40 (1.29)	3.13 (1.21)	3.32 (1.27)	0.300
Negative Attitude	22 (28.57%)	9 (28.13%)	31 (28.44%)	0.468
Neutral Attitude	16 (20.78%)	10 (31.25%)	26 (23.85%)	
Positive Attitude	39 (50.65%)	13 (40.63%)	52 (47.71%)	
All patients with osteoporosis should be offered pharmacotherapy.	4.16 (0.89)	4.03 (0.97)	4.12 (0.91)	0.518
Negative Attitude	4 (5.19%)	3 (9.38%)	7 (6.42%)	0.693
Neutral Attitude	13 (16.88%)	5 (15.63%)	18 (16.51%)	
Positive Attitude	60 (77.92%)	24 (75.00%)	84 (77.06%)	
I am confident in providing non-pharmacotherapy to prevent osteoporosis.	3.66 (1.15)	3.53 (1.27)	3.52 (1.18)	0.601
Negative Attitude	13 (6.88%)	8 (25.00%)	21 (19.27%)	0.394
Neutral Attitude	23 (29.87%)	6 (18.75%)	29 (26.61%)	
Positive Attitude	41 (53.25%)	18 (56.25%)	59 (54.13%)	
I am confident in advising patients for initiation of anti-osteoporotic pharmacotherapy.	3.58 (1.15)	3.31 (1.33)	3.50 (1.21)	0.286
Negative Attitude	15 (19.48%)	9 (28.13%)	24 (22.02%)	0.576
Neutral Attitude	22 (28.57%)	7 (21.88%)	29 (26.61%)	
Positive Attitude	40 (51.95%)	16 (50.00%)	56 (51.38%)	

BMD - Bone Mineral Density

scores and proportions of positive, neutral and negative attitudes among participants were not statistically different (p>0.05).

Practices on Osteoporosis

Descriptive statistics of the practices of screening osteoporosis among the participants is presented in Table 4. It can be noted that only 28.44% screen patients ≥65 years old who are at risk of osteoporosis. Among these participants, 83.87% used bone mineral densitometry (DXA) as the screening tool, while only 41.94% and 12.90% used fracture risk assessment tool (FRAX) and osteoporosis self-assessment tool for Asians (OSTA), respectively. None of the participants used quantitative ultrasound as a screening tool for osteoporosis.

Table 5 illustrates the descriptive statistics and comparative analyses of non-pharmacologic management of osteoporosis among participants according to designation. In general, the non-pharmacologic managements which were practiced

Table 4 Descriptive Statistics on the Practices of Screening for Osteoporosis

Characteristics	Frequency (f)	Percentage (%)
Screening Patients ≥65 Years Old for Osteoporosis Risk	31	28.44%
Screening Tools for Osteoporosis		
Osteoporosis Self-Assessment Tool for Asians (OSTA)	4	12.90%
Fracture Risk Assessment Tool (FRAX)	13	41.94%
Bone Mineral Densitometry (DXA)	26	83.87%
Quantitative Ultrasound (QUS)	0	0.00%

by participants were item 2 ("*I advise patients on fall prevention*"; 85.32%), item 3 ("*I advise patients on adequate calcium intake*"; 74.31%), item 6 ("*I prescribe calcium with Vitamin D supplements*"; 68.81%), and item 7 ("*I refer to medical or orthopedic specialist for anti-osteoporotic medications*"; 65.14%). Among the consultants, the most practiced non-pharmacologic managements were item 1 ("I advise patients for weight-bearing exercise"; 71.88%) and item 2 ("I advise patients on fall prevention"; 87.50%). On the other hand, the most practiced non-pharmacologic management among trainees were item 2 ("I advise patients on fall prevention"; 84.42%), and item 3 ("I advise patients on adequate calcium intake"; 70.13%) Comparative analyses also showed that none of the items of non-pharmacologic management were not statistically significant (p>0.05).

Table 6 presents the descriptive statistics and comparative analyses of perceived barriers to osteoporosis screening and management according to designation. It can be noted that the most commonly perceived barriers were the patient's coexisting multiple medical conditions (93.58%), patient's low socio-economic status (92.66%), inadequate knowledge (83.49%), patient's refusal for screening (80.73%) and inaccessibility of bone density scan (77.06%). Among consultants, the three most perceived barriers were the patient's low socio-economic status (90.63%), patient's multiple medical conditions (87.50%) and patient's refusal for screening. In contrast, the three most perceived barriers among trainees were patient's multiple medical conditions (96.10%), patient's low socio-economic status (93.51%) and inadequate knowledge (88.31%). Comparative analyses of the perceived barriers according to designation showed that most barriers were not statistically significant (p>0.05).

However, results indicated that proportions of participants who perceived inadequate knowledge (88.31% vs. 71.88%, p = 0.048) and inaccessibility of bone density scan (85.71% vs. 56.25%, p = 0.002) were barriers significantly higher among trainees than consultants.

Association of Knowledge and Attitude Scores

Table 7 presents the analysis of the association between knowledge and attitude scores of participants. After categorizing the knowledge and attitude scores, results showed that knowledge and attitude were significantly associated (χ^2=7.67, p = 0.022). In particular, negative attitudes were high among those with unsatisfactory knowledge while neutral attitude was seen higher among those with satisfactory knowledge. Analyses of different items of attitude also showed that most items were not significantly associated with the level of knowledge on osteoporosis (p>0.05). However, it can be noted that the attitude item, *I am confident in providing non-pharmacotherapy to prevent osteoporosis*, was significantly associated with knowledge (χ^2=7.23, p = 0.027). In particular, negative attitudes were higher among those with unsatisfactory knowledge than those with satisfactory knowledge.

DISCUSSION

The overall mean knowledge of participants included in the study was 58.72% and 41.28% demonstrated low knowledge. This is consistent with findings of similar studies done among primary care physicians in Malaysia with a mean knowledge score of 50.46%[8] and in Israel with mean knowledge scores on calcium and vitamin D of 50% and 51% on therapeutic purpose of osteoporotic pharmacotherapy.[9] A study done in Canada that involved healthcare professionals working in fracture clinics, orthopedics, rehabilitation and the nuclear medicine department also echoed this knowledge deficit, especially with regards to health promotion and pharmacotherapy, and also

Table 5 Descriptive Statistics and Comparative Analyses on the Practices of Non-Pharmacologic Management of Osteoporosis among Participants

Non-Pharmacologic Management	Trainees				Consultants				Total				p value
	Never	Seldom	Often	Always	Never	Seldom	Often	Always	Never	Seldom	Often	Always	
Weight-bearing Exercises	5.19%	40.26%	36.36%	18.18%	6.25%	21.88%	31.25%	0.63%	5.50%	4.86%	34.86%	24.77%	0.068
Fall Prevention	2.60%	12.99%	35.06%	49.35%	0.00%	2.50%	28.13%	59.38%	1.83%	12.84%	33.03%	52.29%	0.812
Adequate Dietary Calcium	2.60%	27.27%	30.26%	29.87%	0.00%	15.63%	37.50%	46.88%	1.83%	23.85%	39.45%	34.86%	0.295
Limit Caffeinated Drinks	6.49%	38.96%	33.77%	20.78%	3.13%	31.25%	37.50%	28.13%	5.50%	36.70%	34.86%	22.94%	0.736
Calcium Supplements Only	7.79%	37.66%	38.96%	15.58%	15.63%	56.25	18.75%	9.38%	10.09%	43.12%	33.03%	13.76%	0.082
Calcium with Vitamin D Supplements	5.19%	31.17%	38.96%	24.68%	3.13%	15.63%	56.25%	25.00%	4.59%	26.61%	44.04%	24.77%	0.284
Refer to Medical or Orthopedic Specialists for Pharmacotherapy	7.79%	28.57%	38.96%	24.68%	3.13%	28.13%	31.25%	37.50%	6.42%	28.44%	36.70%	28.44%	0.538

Table 6 Descriptive Statistics and Comparative Analyses of Perceived Barriers to Osteoporosis Screening and Management among Participants

Perceived Barriers	Trainees	Consultants	Total	p value
Lack of doctor-patient time	50 (64.94%)	16 (50.00%)	66 (60.55%)	0.146
Inadequate knowledge	68 (88.31%)	23 (71.88%)	91 (83.49%)	0.048
Inaccessibility of bone density scan using DXA in the district	66 (85.71%)	18 (56.25%)	84 (77.06%)	0.002
Inaccessibility of pharmacotherapy at your clinic	48 (62.34%)	14 (43.75%)	62 (56.88%)	0.074
Difficulty in referral to hospital level	36 (46.75%)	9 (28.13%)	45 (41.28%)	0.072
Worry about side effects of the anti-osteoporotic medication	56 (72.73%)	21 (65.63%)	77 (70.64%)	0.458
Patients' coexisting multiple medical conditions that need more priority	74 (96.10%)	28 (87.50%)	102 (93.58%)	0.095
Patients' lower socio-economic status	72 (93.51%)	29 (90.63%)	101 (92.66%)	0.690
Patients' refusal for screening	64 (83.12%)	24 (75.00%)	88 (80.73%)	0.328

Table 7 Association of Overall Knowledge with Overall Attitude of Participants

	Unsatisfactory Knowledge	Satisfactory Knowledge	X^2 value	p value
Overall Attitude			7.67	0.022
Negative Attitude	19 (42.22%)	14 (21.88%)		
Neutral Attitude	11 (24.44%)	31 (48.44%)		
Positive Attitude	15 (33.33%)	19 (29.69%)		

looked at the most common sources of osteoporosis knowledge, which are mostly from journal articles and case presentations at work.[16] On osteoporosis guidelines, a Germany-based study looking at primary care physicians' awareness of osteoporosis and knowledge of national guidelines showed that only half 51.7% of participants reported good knowledge of their national guidelines.[17] Several of these guidelines are available on the management and treatment of osteoporosis such as those by the American Academy of Clinical Endocrinologists[18] and the Endocrine Society.[19] In our local setting, Li-Yu, et al., together with the Osteoporosis Society of the Philippines Foundation, Inc, the Philippine Orthopedic Association Clinical Practice Guidelines Task Force Committee on Osteoporosis published a consensus statement on osteoporosis diagnosis, prevention and management in the Philippines last 2011.[20]

Only 32.11% of patients correctly answered the question on the definition of osteoporosis, the question with the second lowest percentage of correct answers overall. The lack of knowledge in the definition of osteoporosis found in this study is similar to the findings in the original paper utilizing this questionnaire, [8] with only 31.1% of their participants having satisfactory knowledge on the definition of osteoporosis and with other quantitative studies of this nature.[9,16,17] A qualitative study done among primary care physicians showed one of the major findings was the presence of gaps in knowledge and insufficient awareness of osteoporosis among healthcare workers.[21]

On the question regarding risk factors for osteoporosis, 65.21% answered correctly. More than 90% of the participants were able to identify that women aged >65 years, smokers and those with primary hyperparathyroidism needed to be screened for osteoporosis. The most frequent incorrect answer was a parental history of spine fractures, but a parental history of hip fractures and previous history of low impact wrist fractures was correctly identified as a risk factor by 90% and 80% of participants, respectively; but 79.82% of participants also incorrectly identified hypothyroidism as a risk factor for osteoporosis. The Royal Osteoporosis Society mentions that hypothyroidism itself is not a risk factor for osteoporosis, but excessive thyroid hormone supplementation to treat the condition is.[22] A study in the American Journal of Bone and Mineral Research stated that elevated baseline TSH itself is not associated with an increased risk of fractures, but subsequent 6-month periods with low TSH, which suggests excessive thyroxine dosing was

associated with increased risk of major osteoporotic fractures. Other incorrectly identified risk factors include ischemic heart disease and steroid intake (Prednisolone 40 mg) with gradual reduction over a week.[23] Although 65.21% of participants had satisfactory knowledge when it comes to risk factors for osteoporosis, significantly higher compared to other items in the questionnaire, additional education on the risk factors is still important as screening, and therefore, correctly identifying who needs screening for this disease is of paramount value.

The next domain explored the participants' knowledge on laboratory tests that needed to be requested prior to initiating pharmacotherapy for patients with osteoporosis and was correctly answered by 57.98% of study subjects. Most frequent incorrectly answered diagnostic tests include x-ray of thoracic and lumbar vertebrae (73.39%), x-ray of hip joints (74.31%) and quantitative ultrasound (53.21%). Most participants (97.25%) correctly identified serum creatinine as an important test. However, only 46.18% of participants scored correctly when asked which anti-osteoporotic drugs were safe for patients with an eGFR of <30 mL/min/1.73 m^2 implying a lack of knowledge in the application of serum creatinine results. It is important to emphasize which diagnostic tests are required for patients with osteoporosis as requesting for tests that may not be necessary increase healthcare costs for an already cost-intensive disease.

Seven of the questions of knowledge looked at pharmacotherapy for osteoporosis: recommended daily requirement of calcium and vitamin D, anti-osteoporotic medications that can be given to patients with chronic kidney disease, medications that reduce the risk of osteoporotic hip fractures, complications of osteoporosis treatment, patients requiring treatment without confirmatory tests, maximum duration of bisphosphonate treatment and treatment failure of osteoporosis. Of these items, the questions on treatment failure in osteoporosis had the most correct answers and the lowest scores were on questions regarding the maximum duration of oral bisphosphonate treatment.

Only 43.12% of participants answered correctly about the correct daily requirement for calcium and vitamin D. This is particularly important in Filipinos as seen in the 2003 Food and Nutrition Research Institute of the Philippines Survey where the daily calcium intake of Filipinos averaged only about 440 mg/day.[24] More recent versions of the National Nutrition Survey have not looked at calcium intake, but the 2020 version showed that of the different micronutrient and macronutrient deficiencies in the Philippines, calcium is one of the most common with a prevalence of 95% to 98%.[25] However, calcium and vitamin D supplementation is relatively underutilized with 31.2% of participants in this study saying that they seldom to even never prescribe either calcium or calcium plus vitamin D to patients with risk factors for developing osteoporosis. A study done in Saudi Arabia involving elderly female patients with DXA scan results consistent with osteoporosis showed this as well, with only 54.3% of patients receiving vitamin D supplementation, only 53.4% receiving calcium supplementation and 26.9% of patients receiving no pharmacotherapy at all.[26] This apparent underutilization of calcium and vitamin D supplementation in the Philippines is in contrast to the study by Chan in 2010 involving 237 physicians and 1463 patients with osteoporosis looking at the Asian viewpoint on calcium and vitamin D supplementation in osteoporosis. Among the countries included, the Philippines had the highest proportion of physicians who rated calcium and vitamin D treatment as extremely important (72% for calcium and 73% for vitamin D), with the lowest proportion for physicians in Taiwan (30% for calcium and 12% for vitamin D). Moreover, only patients from the Philippines that were included in this study had regular discussions with their physicians about calcium and vitamin D.[10] As calcium and vitamin D supplementation is important not only for osteoporotic patients but for bone health in general, this is an area that must be addressed.

The mean attitude score of participants across all the questions was 29.23 (SD =1.45, range: 7-35) implying a neutral to somewhat positive attitude. All participants agreed that osteoporosis was an important health issue and that osteoporosis screening was beneficial for patients who were more than 65 years old. However, this does not necessarily translate to practice as seen in the section on Practices on Osteoporosis Screening and Management, where only 28.44% of patients screened were >65 years old for osteoporosis risk. Majority of them also agree that Bone Mineral Density (BMD) should be made more available. However, only 54.13% have generally positive attitudes when asked if they are confident in its interpretation. Similar studies of this

nature reveal that most physicians admit to a lack of confidence in DXA interpretation.[8,9,21] True enough, having less knowledge on osteoporosis was correlated with having less confidence in BMD interpretation (p value = 0.027).

Almost all participants agree that BMD should be made more available and more than a third of participants see the inaccessibility of DXA scanning as a barrier in osteoporosis screening. Among those who screen elderly patients for osteoporosis, DXA is the most frequently reported screening tool used (83.87% of those who screen elderly patients for osteoporosis risk). However, underuse of DXA scans for the screening of patients with osteoporosis still exists. A study in the United States illustrates this, showing a cumulative incidence of DXA screening of 58.8% in women aged 60-64 years with ≥1 risk factor, 57.8% for women aged 65-74 years, and 42.7% for women aged ≥75 years old.[11] Also, 77.06% of participants said that a barrier to osteoporosis screening was the inaccessibility of DXA scan. The Asian Audit, a collection of articles on the epidemiology, costs and burden of osteoporosis in Asia done in 2009 by the International Osteoporosis Foundation showed that in the Philippines, there are only 21 DXA machines all confined to urban centers, which translates to only one DXA machine per 500,000 adults 50 years old and above.[12] Since then, more centers have also made bone densitometry available, but no studies have been done to accurately measure this statistic. However, while bone densitometry is definitely a valuable tool for the diagnosis of osteoporosis, various screening aids that do not require bone mineral densitometry measurement are validated and easily available such as the FRAX score and OSTA score. However, only a minority of the participants utilized this scoring system with only 41.94% using the FRAX score and 12.90% using the OSTA score in those who screened elderly patients for osteoporosis in their practice. Only 65.14% of participants answered correctly when given scenarios where they are asked to initiate pharmacotherapy for osteoporosis without the benefit of a bone densitometry. In another study, [21] some physicians chose not to use the FRAX score because it took valuable time from the patient encounter and was seen as being an extra burden with uncertain value, comparable with the result of this study where a lack of doctor-patient time was also seen as an important barrier to osteoporosis screening and management.

More than half (77.06%) of the participants agreed that patients with osteoporosis should be started on pharmacotherapy. However, only about half of participants are confident in its initiation, and 65% would rather refer to a specialist for anti-osteoporotic medications. This treatment inertia is not ubiquitous in the Philippines as reflected by a study done in France, which showed that in elderly female nursing home residents who had a history of proximal femoral fracture, only 10.3% received bisphosphonates and only 66.4% received vitamin D supplementation.[27] Another study involving 3942 elderly women diagnosed with a fracture of the hip, vertebra, or wrist showed that only 24% of these women received pharmacotherapy for osteoporosis in the year following a fracture.[28]

Overall, this study has demonstrated that a lack of knowledge on osteoporosis was statistically significantly correlated with negative attitudes on osteoporosis screening and management (p value = 0.022).

Equally important in the management of osteoporosis is non-pharmacologic treatment. However, only 54.13% of participants were confident in prescribing non-pharmacologic treatment in their patients. Looking at the questions on practice, the most common non-pharmacologic management prescribed includes health teachings on weight-bearing exercises, fall prevention and dietary modification such as increasing calcium and limiting caffeine intake.

Some of the barriers to osteoporosis screening and management seen in this study are also patient-related factors. The patients' coexisting medical conditions that need more priority are deemed the most important barrier. In the aforementioned qualitative study, osteoporosis was considered a low priority issue when compared to other diseases such as heart disease, diabetes and cancer.[21] Patients' refusal for screening and low socioeconomic status were also seen as major barriers.

Although this was the first study looking at the KAP of physicians in the Philippines with regards to osteoporosis screening and management, there are still several limitations in this paper. This was a self-reported study with a possibility of recall bias. There were also a limited number of participants

who answered this survey and it was recommended to involve a bigger number of participants involving multiple centers so that the results can be more applicable to the general population.

CONCLUSION

Similar to multiple studies exploring the KAP on osteoporosis screening and management, this study has shown that in spite of awareness of osteoporosis as an important health issue, knowledge gaps still exist that translates into a lack of confidence, particularly in initiating treatment for osteoporosis. Therefore, efforts must be made to address these knowledge gaps, improve screening practices and combat treatment inertia in osteoporosis.

REFERENCES

1. Sozen T, Ozisik L, Calik BN. An overview and management of osteoporosis. *European Journal of Rheumatology*, 2017;4(1):46–56. Available from: https://doi.org/10.5152/eurjrheum.2016.048
2. Melmed S, Auchus RJ, Goldfine AB, Koenig RJ, Rosen CJ. *Williams Textbook of Endocrinology*. 2020; Elsevier.
3. Salari N, Ghasemi H, Mohammadi L, Behzadi MH, Rabieenia E, Shohaimi S, et al. The global prevalence of osteoporosis in the world: a comprehensive systematic review and meta-analysis. *J Orthop Surg Res* [Internet]. 2021;16(1):609. Available from: http://dx.doi.org/10.1186/s13018-021-02772-0
4. Miura S, Saavedra OL, Yamamoto S. Osteoporosis in urban postmenopausal women of the Philippines: Prevalence and risk factors. *Archives of Osteoporosis*, 2008;3(1-2):17–24. Available from: https://doi.org/10.1007/s11657-008-0018-0
5. Pouresmaeili F, Kamali Dehghan B, Kamarehei M, Yong Meng G. A comprehensive overview on osteoporosis and its risk factors. *Therapeutics and Clinical Risk Management* , 2018;14:2029–49. Available from: https://doi.org/10.2147/tcrm.s138000
6. Krugh M, Langaker MD. Dual energy x-ray absorptiometry. [Updated 2022 Jun 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK519042/
7. Gehlbach SH, Fournier M, Bigelow C. Recognition of osteoporosis by primary care physicians. *American Journal of Public Health*, 2002;92(2):271–73. Available from: https://doi.org/10.2105/ajph.92.2.271
8. Tay CL, Ng WL, Beh HC, Lim WC, Hussin N. Screening and management of osteoporosis: a survey of knowledge, attitude and practice among primary care physicians in Malaysia. *Arch Osteoporos* [Internet]. 2022;17(1):72. Available from: https://doi.org/10.1007/s11657-022-01111-y
9. Fogelman Y, Goldshtein I, Segal E, Ish-Shalom S. Managing osteoporosis: A survey of knowledge, attitudes and practices among primary care physicians in Israel. PLoS One [Internet]. 2016;11(8):e0160661. Available from: https://doi.org/10.1371/journal.pone.0160661
10. Chan SP, Scott BB, Sen SS. An Asian viewpoint on the use of vitamin D and calcium in osteoporosis treatment: physician and patient attitudes and beliefs. *BMC Musculoskelet Disord* [Internet]. 2010;11(1):248. Available from: https://doi.org/10.1186/1471-2474-11-248
11. Amarnath ALD, Franks P, Robbins JA, Xing G, Fenton JJ. Underuse and overuse of osteoporosis screening in a regional health system: A retrospective cohort study. *J Gen Intern Med* [Internet]. 2015;30(12):1733–40. Available from: http://dx.doi.org/10.1007/s11606-015-3349-8
12. The Asian audit - 2009 [Internet]. Osteoporosis.foundation. [cited 2023]. Available from: https://www.osteoporosis.foundation/educational-hub/files/asian-audit-2009
13. Lautert L. Professional fatigue: Empirical study with hospital nurses. *Revista Gaucha de Enfermagem*, 1997;18(2):133–44.
14. Pera G, Serra-Prat M. Burnout syndrome: Prevalence and associated factors among workers in a district hospital. *Gaceta Sanitaria*, 2002;16(6):480–6.
15. Daniel WW, Cross CL. Biostatistics: A Foundation for Analysis in the Health Sciences. 10th ed. U.S.A.: Wiley & Sons, Inc. 2013.
16. Giangregorio L, Fisher P, Papaioannou A, Adachi JD. Osteoporosis knowledge and information needs in healthcare professionals caring for patients with fragility fractures. *Orthopaedic Nursing*, 2007;26(1):27-35.
17. Chenot R, Scheidt-Nave C, Gabler S, Kochen MM, Himmel W. (2007a) German primary care doctors' awareness of osteoporosis and knowledge of national guidelines. *Experimental and Clinical Endocrinology & Diabetes*, 2007a;115(09):584–9. Available from: https://doi.org/10.1055/s-2007-981454
18. Chenot R, Scheidt-Nave C, Gabler S, Kochen MM, Himmel W. (2007b) German primary care doctors' awareness of osteoporosis and knowledge of national guidelines. *Experimental and Clinical Endocrinology & Diabetes*, 2007b;115(09):584–9. Available from: https://doi.org/10.1055/s-2007-981454
19. Shoback DM, Rosen CJ, Black DM, Cheung AM, Murad MH, Eastell R. Pharmacological management of osteoporosis in postmenopausal women: an endocrine society guideline update. *The Journal of Clinical Endocrinology and Metabolism*, 2020;105(3):587–94. Available from: https://doi.org/10.1210/clinem/dgaa048
20. Li-Yu J, Perez E, Canete A, Bonifacio L, Llamado LQ, Martinez R, Lanzon A, Sison M. Consensus statements on osteoporosis diagnosis, prevention, and management in the Philippines. *International Journal of Rheumatic Diseases*, 2011;14(3):223–38. Available from: https://doi.org/10.1111/j.1756-185x.2011.01626.x
21. Salminen H, Piispanen P, Toth-Pal E. Primary care physicians' views on osteoporosis management: a qualitative study. *Arch Osteoporos* [Internet]. 2019;14(1):48. Available from: https://doi.org/10.1007/s11657-019-0599-9
22. Osteoporosis risk factor: Thyroid Disease. (n.d.). Available from: https://theros.org.uk/information-and-support/osteoporosis/causes/thyroid-disease/
23. Abrahamsen B, Jørgensen HL, Laulund AS, Nybo M, Bauer DC, Brix TH, Hegedüs L. The excess risk of major osteoporotic fractures in hypothyroidism is driven by cumulative hyperthyroid as opposed to hypothyroid time: an observational register - based time - resolved cohort analysis. *Journal of Bone and Mineral Research*, 2015;30(5):898–905. Available from: https://doi.org/10.1002/jbmr.2416
24. Department of Science and Technology, Food and Nutrition Research Institute, 2003 Annual Report.
25. Department of Science and Technology, Food and Nutrition Research Institute, 2020 Annual Report.
26. AlAnazi SM, AlKhamali AA, AlAteeq MA. Practice of family physicians in the management of osteoporosis among older female patients at King Abdulaziz Medical City, Riyadh, Saudi Arabia. *Cureus* [Internet]. 2022;14(2):e22387. Available from: https://doi.org/10.7759/cureus.22387
27. Floch PL, Kermarrec P, Gentric A. Overwhelming underuse of bisphosphonates in French nursing home residents after proximal femoral fracture. *Journal of Nutrition Health & Aging*, 2019;23(4):378–80. Available from: https://doi.org/10.1007/s12603-019-1169-y
28. Andrade SE, Majumdar SR, Chan KM, Buist DSM, Go AS, Goodman M, Smith D, Platt RW, Gurwitz JH. Low

frequency of treatment of osteoporosis among postmenopausal women following a fracture. *Archives of Internal Medicine*, 2003;163(17):2052. Available from: https://doi.org/10.1001/archinte.163.17.2052

APPENDIX A: SAMPLE ONLINE QUESTIONNAIRE (GOOGLE FORM) WITH CORRECT ANSWERS

Osteoporosis is a major public health burden and is associated with significant morbidity and mortality. In spite of this, several studies have demonstrated that osteoporosis is underdiagnosed and undertreated.

This survey aims to determine the knowledge, attitudes, and practices of nonendocrinologist and nonrheumatologist physicians on the diagnosis and management of osteoporosis. The results of this study will help determine gaps in knowledge regarding osteoporosis and provide avenues to improve patient care and help prevent excess morbidity and mortality in patients with osteoporosis.

If you have any questions or concerns about this study, you may contact the author.

SECTION A: BACKGROUND

1. Age: _____ (years)

2. Gender: ☐ Male ☐ Female

3. Designation:
☐ Resident
☐ Fellow
☐ Consultant

4. Department:
☐ Internal Medicine
☐ Family Medicine
☐ Obstetrics and Gynecology
☐ Orthopedics

5. Do you have additional training in management of osteoporosis?
   ☐ No
   ☐ Yes, if yes, please tick the following:
   ☐ Attachment with Geriatrician who manages osteoporosis
   ☐ Attachment with Endocrinologist who manages osteoporosis
   ☐ Attachment with Rheumatologist who manages osteoporosis
   ☐ Attachment with Orthopaedic surgeon who manages osteoporosis

☐ Diploma in Geriatric Medicine or equivalent (completed / on-going)
☐ Others, please specify: _____

6. Years of practice/training: _____ (years)

7. Total number of elderly patients (≥65 years) you see in your current clinic/week? _____/week

8. Do you have access to Bone Mineral Densitometry (DXA)?
☐ No
☐ Unsure
☐ Yes, if yes:
How many BMD were done for the past one year? _____
How do your offer BMD? (You may choose more than one answer)
☐DXA is available at my health clinic / nearby health clinic
☐Direct referral for DXA in Radiology department, hospital (without referring to Medical /Orthopaedic Clinic first)
☐DXA is available at nearby private hospital
☐Other, please specify: _____

9. What is your source of information for management of Osteoporosis? (Please tick more than one if applicable)
☐ Clinical Practice Guidelines
☐ Articles / books
☐ Pharmaceutical representatives
☐ Undergraduate training
☐ Postgraduate training
☐ Colleagues
☐ CME/ Workshop/ Conference/ webinars
☐ Other guidelines, please specify:_____
☐ Social media resources, please tick the following:
☐ UpToDate
☐ Medscape
☐ Other, please specify: _____

10. When was the last time you attended an update lecture on management of osteoporosis:
☐ 0-5 months ago
☐ 6-11 months ago
☐ 12-23 months ago
☐ 2-5 years ago
☐ more than 5 years ago or
☐ Never attended

SECTION B: KNOWLEDGE ON OSTEOPOROSIS

1. Which of the following is true regarding the World Health Organization (WHO) Working group classification of osteoporosis? (Please choose one answer)

☐ Established osteoporosis is defined as T score in BMD ≤ -2.5 SD of the same age adult mean with the presence of ≥ 1 fragility fractures.
☒ Osteoporosis is defined as T score in BMD ≤ -2.5 SD of the young adult mean.

☐ Osteopenia is defined as T score in BMD between -1.0 SD and -2.5 SD below the same age adult mean.
☐ Not sure

2. The following clinical factors / conditions are associated with increased risk of osteoporotic fractures. (Please state if it is true / false / not sure for each item)

Item	True	False	Not sure
2.1 Women aged 65 years and above	√		
2.2 Body mass index < 19kg/m2	√		
2.3 Smoking	√		
2.4 Ischemic heart disease		√	
2.5 A parental history of hip fractures	√		
2.6 A parental history of spine fractures		√	
2.7 Previous low trauma fracture of wrist	√		
2.8 Diabetes Mellitus	√		
2.9 Hypothyroidism		√	
2.10 Rheumatoid arthritis	√		
2.11 Prednisolone 40 mg/day with gradual reduction over a week		√	
2.12 Primary hyperparathyroidism	√		

3. Before initiating pharmacotherapy for osteoporosis, what are the baseline investigations you would perform for a 65-year-old post-menopausal woman with no prior history of fragilty fracture and other risk factor of osteoporosis: (Please state if it is true / false / not sure for each item)

Item	True	False	Not sure
3.1 Serum creatinine	√		
3.2 Full blood count	√		
3.3 Serum albumin	√		
3.4 Serum calcium	√		
3.5 Serum phosphate	√		
3.6 Serum alkaline phosphatase	√		
3.7 Thyroid function test	√		
3.8 Quantitative Ultrasound (QUS)		√	
3.9 Bone density scan using DXA	√		
3.10 X-ray of thoracic and lumbar vertebrae		√	
3.11 X-ray of hip joints		√	
3.12 Bone scan		√	

4. What is the recommended daily requirement of elemental calcium and vitamin D to prevent osteoporosis? (Please choose one answer)
☐ 200 units of vitamin D, 600mg calcium
☐ 400 units of vitamin D, 1200mg calcium
☒ 800units of vitamin D, 1000mg calcium
☐ Not sure

5. Which of the following medications **can** be administered to a osteoporotic person with eGFR <30 mL/min/1.73m^2 ? (Please state if it is true / false / not sure for each item)

Item	True	False	Not Sure
5.1 Raloxifene	√		
5.2 Denosumab	√		
5.3 Teriparatide		√	
5.4 Ibandronate		√	
5.5 Alendronate		√	
5.6 Zoledronate		√	

6. Which of the following pharmacotherapy has been shown to effectively reduce the risk of osteoporotic hip fracture? (Please state if it is true / false / not sure for each item)

Item	True	False	Not Sure
6.1 Raloxifene		√	
6.2 Denosumab	√		
6.3 Teriparatide		√	
6.4 Ibandronate		√	
6.5 Alendronate	√		
6.6 Zoledronate	√		

7. Possible complications associated with the treatment of osteoporosis include the following. (Please state if it is true / false / not sure for each item)

Item	True	False	Not Sure
7.1 IV bisphosphonates is associated with upper gastrointestinal bleeding.		√	
7.2 Bisphosphonates may cause osteonecrosis of the jaw	√		
7.3 Atypical fracture in the femoral shaft in a subtrochanteric site is associated with prolonged use of bisphosphonates.	√		
7.4 Raloxifene may reduce the risk of venous thromboembolism event.		√	
7.5 Raloxifene may aggravate menopausal symptoms		√	
7.6 Teriparatide may cause hypocalcaemia	√		
7.7 Denosumab may cause myalgia especially among patients with vitamin D deficiency	√		

8. Which of the following patients would you start osteoporosis treatment without waiting for confirmatory testing of BMD? (Please state if it is true / false / not sure for each item)

Item	True	False	Not Sure
A. 8.1 A 66 year-old female patient, generally healthy, with a crack fracture at the ankle after fall from a meter-high lorry.		√	
B. 8.2 A 76 year-old male with a L4-vertebra compression fracture after lifting a book off the floor.	√		
C. 8.3 A 68 year-old female, generally healthy, with a collapsed L4-vertebra after falling from a meter-high rock while hiking.		√	
D. 8.4 A 74 year-old female with a neck of femur fracture caused by a fall in the garden while weeding.	√		

9. How long is the maximum duration of oral bisphosphonate treatment? (Please choose one answer)
   - ☐ 3-5 years
   - ☒ 5-10 years
   - ☐ Lifelong treatment
   - ☐ Not sure

10. Below is/are true regarding treatment failure in osteoporosis: (You may choose more than one answer).

Item	True	False	Not Sure
A) Treatment failure can be defined as ≥ 2 new fragility fractures while taking the anti-osteoporosis medication	√		
B) We need to rule out non-adherence to medications	√		
C) We need to rule out secondary causes of osteoporosis	√		
D) Oral Bisphosphonate could be switched to IV Bisphosphonate	√		
E) Bisphosphonate could be switched to Denosumab	√		

SECTION C: ATTITUDE TOWARDS OSTEOPOROSIS

Please indicate (√) your level of agreement with the following statements

No.	Item	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1.	Osteoporosis is an important health issue.					
2.	Osteoporosis screening is beneficial for patients who are ≥ 65 years.					
3.	BMD assessment should be made easily accessible to primary care doctors.					
4.	I am confident in BMD result interpretation.					
5.	All patients with osteoporosis should be offered for pharmacotherapy.					
6.	I am confident in providing nonpharmacotherapy to prevent osteoporosis.					
7.	I am confident in advising patients for initiation of anti-osteoporotic pharmacotherapy.					
8.	Bisphosphonate should be changed of category prescriber from A (Consultant/ Specialist) to A/ KK (Consultant/Specialist/ Family Medicine Specialist).					

SECTION D: PRACTICE OF OSTEOPOROSIS SCREENING AND MANAGEMENT FOR OSTEOPOROTIC FRACTURE RISK REDUCATION

1. Do you ever screen those age ≥ 65 years for risk of osteoporosis in your practice?
   - ☐ No
   - ☐ Yes, if yes: -
     - A) How many do you screen monthly? _____/month
     - B) Which screening tool do you adopt in your clinical practice? (please tick as many as appropriate)
       - ☐ Osteoporosis Self-Assessment Tool for Asians (OSTA)
       - ☐ Fracture Risk Assessment Tool (FRAX)
       - ☐ BMD (DXA)
       - ☐ QUS

2. What is your management to reduce fracture risk in patients with osteoporosis in your practice? Please select the responses (never, seldom, often or always) for every statement. Please specify in 'Others' if your management is not listed here.

Statement	Responses			
	Never	Seldom	Often	Always
M1. I advise patients for weight-bearing exercise				
M2. I advise patients on fall prevention				
M3. I advise patients on adequate dietary calcium intake				
M4. I advise patients to limit caffeinated drinks intake to less than 1-2 (240-360ml in each serving) servings per day.				
M5. I prescribe calcium supplement only				
M6. I prescribe calcium with vitamin D supplements				
M7. I refer to medical or orthopedic specialist for anti-osteoporotic medications				

3. What do you perceive as barrier(s) to Osteoporosis screening & management in your practice? Please select the responses (Yes or No) for every statement. Please specify in 'Others' if the barrier is not listed here.

BARRIERS	RESPONSES	
B1. Lack of doctor-patient time	☐ Yes	☐ No
B2. Inadequate knowledge	☐ Yes	☐ No
B3. Inaccessibility of bone density scan using DXA in the district	☐ Yes	☐ No
B4. Inaccessibility of pharmacotherapy at your clinic	☐ Yes	☐ No
B5. Difficulty in referral to hospital level	☐ Yes	☐ No
B6. Worry about side effects of the anti-osteoporotic medication	☐ Yes	☐ No
B7. Patients' coexisting multiple medical conditions that need more priority	☐ Yes	☐ No
B8. Patients' lower socio-economic status	☐ Yes	☐ No
B9. Patients' refusal for screening	☐ Yes	☐ No
Others: specify _____		

Descriptive Statistics and Comparative Analyses of the Knowledge Items and Percentage Correct Responses according to Designation of the Participants (*N* = 109)

Item	Knowledge Items	Designation (N = 109)						*p*-value (Two-Tailed)
		Trainees (n = 77)		Consultants (n = 32)		Total (N = 109)		
		Frequency Correct (%)	Frequency Correct	Frequency Correct (%)	Frequency Correct	Frequency Correct (%)	Frequency Correct	
1	**Definition of Osteoporosis**	27 (35.06%)	35.06% (48.03)	8 (25.00%)	25.00% (3.99)		32.11% (46.91)	0.310
2	**Risk Factors of Osteoporosis**		66.34% (12.27)		62.50% (10.79)		65.21% (11.94)	0.127
	Women aged ≥65 Years Old	77 (100.00%)		32 (100.00%)		109 (100.00%)		
	Body Mass Index <19kg/m2	49 (63.64%)		25 (78.13%)		74 (67.89%)		
	Smoking	72 (93.51%)		31 (96.88%)		103 (94.50%)		
	Ischemic Heart Disease	34 (44.16%)		7 (21.88%)		41 (37.61%)		
	Parental History of Hip Fractures	65 (84.42%)		25 (78.13%)		90 (82.57%)		
	Parental History of Spine Fractures	23 (29.87%)		0 (0.00%)		23 (21.10%)		
	Previous Low Trauma Fracture of Wrist	58 (75.32%)		22 (68.75%)		80 (73.39%)		
	Diabetes Mellitus	56 (72.73%)		30 (93.75%)		86 (78.90%)		
	Hypothyroidism	19 (24.68%)		3 (9.38%)		22 (20.18%)		
	Rheumatoid Arthritis	63 (81.82%)		26 (81.25%)		89 (81.65%)		
	Prednisolone Intake	23 (29.87%)		12 (37.50%)		35 (32.11%)		
	Primary Hyperparathyroidism	74 (96.10%)		27 (84.38%)		101 (92.66%)		
3	**Laboratory Tests for Osteoporosis**		68.94% (13.36)		65.89% (19.67)		68.04% (15.45)	0.350
	Serum Creatinine	76 (98.70%)		30 (93.75%)		106 (97.25%)		
	Full Blood Count	63 (81.82%)		26 (81.25%)		89 (81.65%)		
	Serum Albumin	57 (74.03%)		23 (71.88%)		80 (73.39%)		
	Serum Calcium	74 (96.10%)		31 (96.88%)		105 (96.33%)		
	Serum Phosphate	71 (92.21%)		27 (84.38%)		98 (89.91%)		
	Serum Alkaline Phosphatase	58 (75.32%)		22 (68.75%)		80 (73.39%)		
	Thyroid Function Test	68 (88.31%)		25 (78.13%)		93 (85.32%)		
	Quantitative Ultrasound (QUS)	41 (53.25%)		10 (31.25%)		51 (46.79%)		
	Bone Density Scan using DXA	71 (92.21%)		27 (84.38%)		98 (89.91%)		

Descriptive Statistics and Comparative Analyses of the Knowledge Items and Percentage Correct Responses according to Designation of the Participants (*N* = 109) (Continued)

Item	Knowledge Items	Designation (N = 109)						
		Trainees (n = 77)		Consultants (n = 32)		Total (N = 109)		*p*-value (Two-Tailed)
	X-Ray of Thoracic and Lumbar Vertebrae	18 (23.38%)		11 (34.38%)		29 (26.61%)		
	X-Ray of Hip Joints	19 (24.68%)		9 (28.13%)		28 (25.69%)		
	Bone Scan	21 (27.27%)		12 (37.50%)		33 (30.28%)		
4	**Recommended Daily Requirement of Calcium and Vitamin D**	36 (46.75%)	46.75% (50.22)	11 (34.38%)	34.38% (48.26)	47 (43.12%)	43.12% (49.75)	0.239
5	**Medications of Osteoporotic Persons for eGFR <30 mL/min/1.73m2**							
	46.75% (31.88)		44.79% (32.36)		46.18% (31.88)	0.771		
	Raloxifene	29 (37.66%)		6 (18.75%)		35 (32.11%)		
	Denosumab	48 (62.34%)		18 (56.25%)		66 (60.55%)		
	Teriparatide	23 (29.87%)		9 (28.13%)		32 (29.36%)		
	Ibandronate	40 (51.95%)		16 (50.00%)		56 (51.38%)		
	Alendronate	36 (46.75%)		18 (56.25%)		54 (49.54%)		
	Zoledronate	40 (51.95%)		19 (59.38%)		59 (54.13%)		
6	**Pharmacotherapeutics to Reduce Osteoporotic Hip Fracture Risk**	46.32% (20.16)		38.54% (1.35)		44.04% (20.73)	0.074	
	Raloxifene	11 (14.29%)		2 (6.25%)		13 (11.93%)		
	Denosumab	57 (74.03%)		21 (65.63%)		78 (71.56%)		
	Teriparatide	17 (22.08%)		2 (6.25%)		19 (17.43%)		
	Ibandronate	15 (19.48%)		2 (6.25%)		17 (15.60%)		
	Alendronate	57 (74.03%)		23 (71.88%)		80 (73.39%)		
	Zoledronate	57 (74.03%)		24 (75.00%)		81 (74.31%)		
7	**Complications of Osteoporosis Treatment**	53.06% (27.01)		41.07% (24.81)		49.54% (26.84)	0.033*	
	IV bisphosphonate is associated with upper gastrointestinal bleeding.	26 (33.77%)		9 (28.13%)		35 (32.11%)		
	Bisphosphonates may cause osteonecrosis of the jaw	58 (75.32%)		25 (78.13%)		83 (76.15%)		

Descriptive Statistics and Comparative Analyses of the Knowledge Items and Percentage Correct Responses according to Designation of the Participants (*N* = 109) (Continued)

Item	Knowledge Items	Designation (N = 109)						
		Trainees (n = 77)		Consultants (n = 32)		Total (N = 109)		*p*-value (Two-Tailed)
	Atypical fracture in the femoral shaft in a sub-trochanteric site is associated with prolonged use of bisphosphonates.	53 (68.83%)		15 (46.88%)		68 (62.39%)		
	Raloxifene may reduce the risk of venous thromboembolism event.	32 (41.56%)		11 (34.38%)		43 (39.45%)		
	Raloxifene may aggravate menopausal symptoms	47 (61.04%)		11 (34.38%)		58 (53.21%)		
	Teriparatide may cause hypocalcemia	21 (27.27%)		6 (18.75%)		27 (24.77%)		
	Denosumab may cause myalgia especially among patients with vitamin D deficiency	49 (63.64%)		15 (46.88%)		64 (58.72%)		
8	**Patients requiring Treatment without Confirmatory Tests**	65.91% (28.07)		63.28% (27.67)		65.14% (27.85)	0.656	
	A 66 year-old female patient, generally healthy, with a crack fracture at the ankle after fall from a meter-high lorry.	38 (49.35%)		15 (46.88%)		53 (48.62%)		
	A 76 year-old male with a L4-vertebra compression fracture after lifting a book off the floor.	67 (87.01%)		27 (84.38%)		94 (86.24%)		
	A 68 year-old female, generally healthy, with a collapsed L4-vertebra after falling from a meter-high rock while hiking.	34 (44.16%)		12 (37.50%)		46 (42.20%)		
	A 74 year-old female with a neck of femur fracture caused by a fall in the garden while weeding.	64 (83.12%)		27 (84.38%)		91 (83.49%)		
9	**Maximum Duration of Oral Bisphosphonate Treatment**	18 (23.38%)	23.38% (42.60)	3 (9.38%)	9.38% (29.61)	21 (19.27%)	19.27% (39.62)	0.093
10	**Treatment Failure of Osteoporosis**		69.35% (34.12)		69.38% (30.05)		69.36% (32.84)	0.997

Descriptive Statistics and Comparative Analyses of the Knowledge Items and Percentage Correct Responses according to Designation of the Participants (*N* = 109) (Continued)

Item	Knowledge Items	Designation (N = 109)					
		Trainees (n = 77)	Consultants (n = 32)	Total (N = 109)		*p*-value (Two-Tailed)	
	Treatment failure can be defined as ≥ 2 new fragility fractures while taking the anti-osteoporosis medication	56 (72.73%)	22 (68.75%)	78 (71.56%)			
	We need to rule out non-adherence to medications	61 (79.22%)	27 (84.38%)	88 (80.73%)			
	We need to rule out secondary causes of osteoporosis	64 (83.12%)	29 (90.63%)	93 (85.32%)			
	Oral Bisphosphonate could be switched to IV Bisphosphonate	38 (49.35%)	13 (40.63%)	51 (46.79%)			
	Bisphosphonate could be switched to Denosumab	48 (62.34%)	20 (62.50%)	68 (62.39%)			
Overall Knowledge ($\bar{x}$, SD)		59.43 (12.11)	54.49 (14.18)		57.98 (12.89)	0.068	
Overall Knowledge Categories (f, %)					1.42	0.233	
Unsatisfactory (Correct Responses <60%)		29 (37.66%)	16 (50.00%)	45 (41.28%)			
Satisfactory (Correct Responses ≥60%)		48 (62.34%)	16 (50.00%)	64 (58.72%)			

**Significant* at 0.05
†Significant at 0.01