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# Knowledge gap regarding osteoporosis among medical professionals in Southern India

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## Abstract

**Rationale, aims, and objectives:** Osteoporosis is a common health problem in India, which leads to significant morbidity and mortality in elderly individuals. Lack of knowledge and awareness among medical professionals is one of the important barriers in management of these patients. Therefore, this study was conducted to assess knowledge pertaining to diagnosis and treatment of osteoporosis among a group of Indian medical practitioners.

**Methods:** The study participants included 222 allopathic medical professionals, either graduate or postgraduate working in primary or secondary health care levels. They were assessed using a previously validated Fogelman's multiple choice questionnaire. Out of a total of 18 questions, four questions pertained to knowledge of diagnosis, three questions to treatment decisions, one question to assess knowledge regarding recommended dosage of vitamin D and calcium supplementation, five questions concerned medication use, and the rest to assess attitude and practices. The correct answers were converted into scores and expressed as percentages with a maximum of 100.

**Results:** The mean total score among them was 22.5%, which was quite low. Almost all of them had a score of less than 50%. Medical practitioners performed better in diagnosis-related questions, (19.4% answered all options correctly) than in medication knowledge (no correct response regarding side effects and 2% regarding contraindications). In treatment-related decisions, 37.4% answered correctly for duration of treatment, and 59% answered correctly for treatment goal. Only 1.4% of them were able to answer correctly regarding recommended calcium and vitamin D intake. Professional literature, conferences, and Continuing Medical Education (CME's) were regarded as the main sources of information on the subject by 40% of practitioners.

**Conclusion:** This study showed suboptimal knowledge among a group of medical professionals regarding various aspects of diagnosis and management of osteoporosis, and it stipulates the need for escalating the efforts to improve their knowledge regarding various aspects of osteoporosis.

  

KEYWORDS
India, knowledge gap, medical professionals, osteoporosis

## 1 | INTRODUCTION

Osteoporosis is a systemic skeletal disease characterized by low bone mineral density as well as microarchitectural degradation leading to increased risk of low trauma fractures.[1] It is one of the major public health problems worldwide as well as in India.[2] About 40% to 50% of Indian postmenopausal women have osteoporosis, and this figure is expected to rise further as life expectancy of the Indian population increases.[3,4] Osteoporotic fractures particularly at the hip leads to significant mortality, morbidity, and an impaired quality of life.[5] Patients with osteoporotic hip fractures often need surgical correction, which also imposes significant financial burden on the family as well as on the community.[6]

India, located in Southern Asia, is the second most populous country in the world, its population numbering more than 1.3 billion. The health care system in India consists of both public and private health care sectors. However, most of the private health care providers are concentrated in the urban areas. The public health care infrastructure in the rural region is modelled on a three-tier system, based on population norms, and consists of subcentres, primary health centres, and community health centres.[7] As about 70% of the Indian population dwell in rural communities, they are entirely dependent on the primary health care system provided by the government to meet their basic health needs.[8] Vitamin D deficiency is widely prevalent in India, and this has an adverse effect on bone health in postmenopausal women. Also, there is no consensus among treating physicians about the dosing schedule in treating this condition. Vitamin D toxicity has also been reported to occur from the indiscriminate use of high-dose vitamin D supplements owing to poor awareness on the part of the prescribing physicians.[9] Although considerable emphasis on osteoporosis is only given in training programmes of a few specialties, the medical curriculum at the undergraduate and postgraduate level in several disciplines gives little focus on osteoporosis-related education.[10]

Moreover, there are more than 100 million postmenopausal women in India, and more than two-thirds of them reside in rural areas.[11] As about 50% of them are likely to have osteoporosis and the one year mortality from a resultant osteoporotic hip fracture is about 20%, the onus is on the physicians at the primary and secondary care levels to detect this condition sufficiently early.[5,12] Thus, medical practitioners especially at the primary care level play an important role, as majority of patients suffering from osteoporosis have to be managed by them.[2] A thorough understanding of the prevailing level of awareness among primary care physicians is absolutely vital in identifying potential lacunae in knowledge and attempting to close these gaps. Previous studies have shown significant flaws in diagnosis as well as management of patients with osteoporotic fractures.[13,14] Therefore, lack of knowledge regarding osteoporosis among medical professionals may be one of the important barriers to appropriate management of this disorder. Perez-Edo et al[15] and Taylor et al[16] have observed suboptimal knowledge regarding diagnosis and management of osteoporosis among general practitioners in Spain and United Kingdom, respectively. However, there has not yet been any study reported from India, in this regard.

Hence, this study was conducted to assess the knowledge of medical professionals regarding the diagnosis and management of osteoporosis, as well as to determine the barriers faced by them in the treatment of the same.

## 2 | METHODOLOGY

This was a cross sectional study done over a period of 6 months between 1 February 2018 and 31 July 2018. Endocrine and diabetes CMEs are conducted in this tertiary care centre every 2 to 3 months for both primary and secondary care physicians with either a graduate or postgraduate qualification. The duration of undergraduate medical programme in India is 5.5 years, which includes 1 year of compulsory internship in various clinical departments. The postgraduate training is for a period of 3 years followed by an exit exam. The curriculum for these training programmes is regulated and periodically reviewed by an independent central governing body.

All physicians attending these CMEs were informed about this study. Among those who expressed interest in participation, subjects were recruited using simple random sampling. Informed consent was taken from the participants who were engaged in the study. This study was approved by the Institutional Review Board (Research and ethics committee) of Christian Medical College at Vellore.

A self-administered multiple choice-based questionnaire, (Table 1) derived by Fogelman et al,[17] was used to assess knowledge, attitude, and practices of physicians in this study. The content in the questionnaire was validated by two experts in osteoporosis.[17] The questionnaire consisted of 18 multiple choice-based questions (13 of 18 questions shown in Table 1) out of which four questions assessed the participants' knowledge regarding the diagnosis; three questions assessed their treatment decisions, five questions assessed medication use including mechanism of action, contraindications to use, and side effects; and one question assessed knowledge regarding recommended dosage of vitamin D supplementation.

In the remaining questions,[14 to 18] practitioners were asked regarding their source of knowledge acquisition, source of knowledge update, self-evaluation of their knowledge, and barriers faced by them while managing patients with osteoporosis. As the responses to these questions were subjective and differed among the participants, these have not been included in Table 1. The questionnaires were handed over by the study investigators to the

**TABLE 1** Fogelman's questionnaire with correct responses

| Q. no. | Question | Correct Response (%) |
|---|---|---|
| 1. | Tests to be done for a 60-year-old asymptomatic female patient before deciding on the need for osteoporotic pharmacotherapy. (multiple correct answers) | |
| A. | Serum levels of calcium, phosphorus, albumin, creatinine, blood count | ✓ |
| B. | Bone density scan using DXA | ✓ |
| C. | Ultrasound bone density scan | |
| D. | X-ray of thoracic and lumbar vertebrae | |
| E. | Medical history and physical examination | ✓ |
| F. | Bone scan | |
| 2. | Which patients should be started on treatment without confirming the diagnosis of osteoporosis with investigations? (multiple correct answers) | |
| A. | 45-year-old healthy female patient, regular menstrual cycle with TSCORE −2.9 in L1-L4 | |
| B. | 76-year-old male with an intertrochanteric fracture caused by falling from a standing height. | ✓ |
| C. | 68-year-old healthy female, with a collapsed L4 vertebra after falling from a meter-high rock. | |
| D. | 74-year-old female with a subcapital hip fracture caused by a fall in the garden while weeding. | ✓ |
| 3. | What are the clinical factors associated with increased risk of osteoporotic fractures? (multiple correct answers) | |
| A. | Age > 65 | ✓ |
| B. | Female gender | ✓ |
| C. | Presently smoking | ✓ |
| D. | Parental history of femoral fractures | ✓ |
| E. | Present alcohol consumption of more than three servings per day | ✓ |
| 4. | What are the clinical conditions that increase the risk for osteoporotic fractures? (multiple correct answers) | |
| A | Chronic oral glucocorticoid treatment (more than 3 consecutive months) | ✓ |
| B. | Rheumatoid arthritis | ✓ |
| C. | Type 2 diabetes | ✓ |
| D. | Underactive thyroid gland | |
| E. | Type 1 diabetes | ✓ |
| F. | Overactive thyroid gland | ✓ |
| G. | Glucocorticoid treatment at a dosage of 40 mg with gradual reduction over the course of a week | |
| H. | Ischemic heart disease | |
| I. | Primary hyperparathyroidism | ✓ |
| 5. | What is the recommended dosage of calcium and vitamin D supplement for postmenopausal women? | |
| A. | 200 units of vitamin D, 600-mg calcium | |
| B. | 400 units of vitamin D, 1200-mg calcium | |
| C. | 600 units of vitamin D, 1000-mg calcium | |
| D. | 800 units of vitamin D, 600-mg calcium | |
| E. | Dosage to be determined by the patient's dietary habits and lifestyle | ✓ |
| 6. | What is the therapeutic goal for a 66-year-old patient diagnosed with osteoporosis and treated with Alendronate and calcium 600 mg/day? (one correct answer) | |
| A. | Increasing the bone density in spinal vertebra by at least 2% in 2 years | |
| B. | Reducing the risk of fracture by 25% to 50% in the various skeletal sites | ✓ |
| C. | Increasing bone density by 5% or more in the femoral shaft, within two years | |
| D. | Increasing bone density by 6% within 5 years, in spinal vertebra. | |
| 7. | 54-year-old lady with severe menopausal symptoms on HRT for 1 year, which has greatly improved her quality of life. Her T-SCORE at L1-L4 is - 3 SD, and hip is −2.4 SD. She is on calcium 600 mg/day and 1000 IU of vitamin D per day. What is your recommendation? (one correct answer) | |
| A. | Add Alendronate 70 mg/week to HRT | |

(Continues)

**TABLE 1** (Continued)

| Q. no. | Question | Correct Response (%) |
|---|---|---|
| B. | Stop HRT and begin treatment with Raloxifene | |
| C. | Continue treatment unchanged | ✓ |
| D. | Add treatment with Risedronate 150 mg/month to the HRT | |
| E. | Add treatment with Zoledronate by intravenous administration once a year | |
| F. | Stop HRT and begin treatment with Alendronate 70 mg/week | |
| 8. | The maximum treatment duration with bisphosphonates for which fracture risk reduction was demonstrated in postmenopausal women is ? (one correct answer) | |
| A. | Two years | |
| B. | Three to six years | ✓ |
| C. | Unlimited duration of treatment | |
| D. | The period of time required for an increase in bone density of at least 6% in vertebra | |
| E. | Duration can range from 2-10 years, depending on the type of bisphosphonates administered | |
| 9. | Sort below mentioned medications according to their mechanism of action. (antiresorbing agent [mark 1] vs anabolic agent [mark 2]) | |
| A. | Alendronate | 1 |
| B. | Raloxifene | 1 |
| C. | Teriparatide | 2 |
| D. | Risedronate | 1 |
| E. | Denosumab | 1 |
| F. | Zoledronate | 1 |
| 10. | True about the follow-up for a patient with osteoporosis, using a bone mineral density test with DXA is ?(one correct answer) | |
| A. | The test is the most effective means for evaluating the response to therapy at the individual level | |
| B. | This test is recommended annually for patients with severe osteoporosis who are taking medication | |
| C. | This test is recommended once every two years for osteoporosis patients during treatment, to assess response to the treatment and recovery from the disease | |
| D. | If a decrease in bone density by 2% or more is observed, the medication needs to be adjusted | |
| E. | None of the above | ✓ |
| 11. | What characterizes an atypical fracture of the hip? (one correct answer) | |
| A. | An osteoporotic fracture that occurs in the femur under the trochanter | |
| B. | A fracture that appears in a subtrochanteric site in the femoral shaft while a patient is being treated with teriparatide | |
| C. | A fracture in the femoral shaft in a subtrochanteric site associated with prolonged use of bisphosphonates | ✓ |
| D. | A hard-to-heal osteoporotic fracture | |
| 12. | The following (Alendronate, Raloxifene, Teriparatide, Risedronate, Denosumab, and Zoledronate) medications are used in treating osteoporosis. Beneath is a list of possible complications associated with the treatment. Please match the common complication to the medication that may trigger it. | |
| A. | Venous thromboembolism event | |
| B. | Hypocalcemia | |
| C. | Musculoskeletal pain | |
| D. | Upper gastrointestinal bleeding | |
| E. | Epigastric pain and heartburn | |
| F. | Esophagitis | |
| G. | Erysipelas | |
| H. | Muscle pain, flu-like symptoms | |
| I. | Hypercalcemia | |
| J. | Aggravation of menopausal symptoms | |

(Continues)

**TABLE 1** (Continued)

| Q. no. | Question | Correct Response (%) |
|---|---|---|
| 13. | Which of the following medications should not be administered to an osteoporosis patient with eGFR <35? | |
| A. | Alendronate | ✓ |
| B. | Raloxifene | |
| C. | Teriparatide | |
| D. | Risedronate | ✓ |
| E. | Denosumab | |
| F. | Zoledronate | ✓ |

Abbreviations: BMD, bone mineral density; DXA, dual X-ray absorptiometry; eGFR, estimated glomerular filtration rate; HRT, Hormone Replacement Therapy.

medical professionals attending the CME. The demographic and professional details including years of experience and specialty of the medical practitioners were recorded.

Unanswered questions were regarded as incorrect, as it indicated a lack of knowledge in that area. For questions that had multiple correct answers (question no 1-4 and 13), overall correct response was defined as answering all correct responses without marking an incorrect response. Thus, for each question, the proportion of participants who answered correctly was calculated.

## 3 | STATISTICAL METHODS

Based on a previous study,[17] the number of subjects needed for the study was 196, considering a prevalence of 50% of unawareness and 10% allowable error. The age and experience of the participants were expressed as mean and standard deviations. The total test score per participant was calculated as number of all correct responses (Question 1-13 in the questionnaire) answered by the participant divided by the perfect score of 38 and was mentioned as percentage (0%-100%). The total test scores were compared with age, seniority, gender, and specialty using independent *t* test using SPSS version 21.

Responses to questions regarding last lecture attended on osteoporosis and effective way of updating knowledge were presented as percentages. In question no 14 and 17, participants were asked to rate their source of knowledge on osteoporosis and barriers to management of osteoporosis respectively, from 1 to 5; with higher the score, better was the significance. Rates of 4 and 5 were regarded by us as significant resources, and the same was used to compile the percentage of participants that rated each resource as significant.

## 4 | RESULTS

Two hundred eighty-four practitioners were approached, out of which 222 (78.7 %) agreed to participate in this study.

## 5 | PROFESSIONAL DETAILS

Of 222 practitioners, 88 (43.8%) participants were females. The mean experience in years and age of the participants according to their specialty are presented in Table 2. The proportion of overall correct responses in multiple choice questions are depicted in Table 3.

Summary of correct and incorrect responses of participants is presented in Figure **1**. Participants scored better in questions concerning treatment-related decisions than in questions relating to diagnosis and medications used to treat osteoporosis. Overall, the mean (SD) of total score (expressed as percentage) of questions 1 to 13 in the questionnaire was 22.5[9] % in the study subjects. Ninety-nine percent of subjects had a score less than 50%.

### 5.1 | Diagnosis of osteoporosis

Four questions assessed the knowledge of participants regarding diagnosis of osteoporosis. For the first question, only 19% of participants marked all the options correctly, ie, relevant blood tests (serum calcium, phosphorus, albumin, creatinine, and blood count), bone mineral density with Dual Energy X-ray Absorptiometry (DXA), history, and physical examination to be done for a 60-year-old asymptomatic woman before deciding on the need for osteoporotic pharmacotherapy. Also, only 45% of the total participants marked DXA scan as a correct response, which shows lack of awareness regarding DXA as a diagnostic tool for osteoporosis among doctors.

**TABLE 2** Details of participants

| | | Specialty | | |
|---|---|---|---|---|
| Variable | All | Graduate | Postgraduate (Internal Medicine) | Postgraduate (Others) |
| No. of practitioners | 222 | 115 (51.8%) | 80 (36%) | 27 (12.2%) |
| Age in years (mean ± SD) | 43.1 ± 9.9 | 41.9 ± 9.9 | 43.2 ± 9.2 | 47.9 ± 11.2 |
| Experience in years (mean±SD) | 13.7 ± 9.8 | 13.7 ± 9.9 | 12.1 ± 8.8 | 18.2 ± 10.9 |

**TABLE 3** Overall correct responses

| Q.no. | Question | All Correct Responses (%) |
|---|---|---|
| 1. | Tests to be done for a 60-year-old asymptomatic female patient before deciding on the need for osteoporotic pharmacotherapy. (multiple correct answers) | 19.4 |
| 2. | Which patients should be started on treatment without confirming the diagnosis of osteoporosis with investigations? (multiple correct answers) | 11.7 |
| 3. | What are the clinical factors associated with increased risk of osteoporotic fractures? (multiple correct answers) | 5.9 |
| 4. | What are the clinical conditions that increase the risk for osteoporotic fractures? (multiple correct answers) | 0.9 |
| 5. | What is the recommended dosage of calcium and vitamin D supplement for postmenopausal women? | 1.4 |
| 6. | What is the therapeutic goal for a 66-year-old patient diagnosed with osteoporosis and treated with Alendronate and calcium 600 mg/day? (one correct answer) | 59 |
| 7. | 54-year-old lady with severe menopausal symptoms on HRT for 1 year, which has greatly improved her quality of life. Her T-SCORE at L1-L4 is - 3 SD, and hip is −2.4 SD. She is on calcium 600 mg/day, and 1000 IU of vitamin D per day. What is your recommendation? (one correct answer) | 23 |
| 8. | The maximum treatment duration with bisphosphonates for which fracture risk reduction was demonstrated in postmenopausal women is? (one correct answer) | 37.4 |
| 9. | Sort below mentioned medications according to their mechanism of action. (anti resorbing agent Vs anabolic agent) | 1.4 |
| 10. | True about the follow-up for a patient with osteoporosis, using a bone mineral density test with DXA is ?(one correct answer) | 5.4 |
| 11. | What characterizes an atypical fracture of the hip? (one correct answer) | 23.9 |
| 12. | The following (Alendronate, Raloxifene, Teriparatide, Risedronate, Denosumab, and Zoledronate) medications are used in treating osteoporosis. Beneath is a list of possible complications associated with the treatment. Please match the common complication to the medication that may trigger it. | 0.5 |
| 13. | Which of the following medications should not be administered to an osteoporosis patient with eGFR <35? | 0.5 |

Abbreviations: DXA, Dual Energy X-ray Absorptiometry; eGFR, estimated glomerular filtration rate.

For the second question, "Which patients should be started on treatment without confirming the diagnosis of osteoporosis with investigations?" only 11% of participants marked both the correct responses without an incorrect response. However, 51% chose "a 76-year-old gentleman with an intertrochanteric hip fracture caused by falling from a standing height after tripping on the carpet" as correct response, and 47% selected "a 74-year-old lady with a subcapital hip fracture caused by a fall in the garden while weeding" as a correct response.

Only 6% of participants answered correctly that age more than 65 years, female sex, smoking, family history of hip fractures, and alcohol consumption are risk factors for osteoporotic fractures. Among the participants, 74% and 65 % marked older age and female sex as risk factors for osteoporosis, respectively.

For the question, "Which clinical conditions increase the risk of osteoporotic fractures?" none were able to mark all six correct responses although 39% and 65% of participants marked hyperparathyroidism and chronic glucocorticoid use as clinical conditions associated with osteoporosis respectively.

## 5.2 | Vitamin D and calcium supplementation

No more than three participants (1.4%) were able to answer correctly that dosage of vitamin D and calcium should be determined by patient's dietary habits and lifestyle. Among the study subjects, 42% of the participants chose 600 IU of vitamin D and 1 gm of calcium supplementation as their response to the above-mentioned question.

## 5.3 | Treatment decisions

There were three questions in the questionnaire that assessed the participants' knowledge regarding treatment decisions for osteoporosis.

For the first question, majority (59%) of participants answered correctly that reducing risk of fracture by 25% to 50% is the treatment goal for a 66-years-old patient with osteoporosis on alendronate and 600 mg/day of calcium. Just 23% of participants marked correctly that treatment of a 54-year-old lady with severe menopausal symptoms and low bone mineral density (BMD) should remain unchanged as she has marked improvement in her quality of life with hormonal replacement therapy. For the third question on the subject, 37% of participants answered correctly that maximum treatment duration with bisphosphonates should be 3 to 6 years.

## 5.4 | Medications for osteoporosis

For the question regarding mechanism of action of drugs used for treatment of osteoporosis, 43%, 19%, 45%, 25%, and 31% of participants correctly labelled alendronate, raloxifene, risedronate, denosumab, and zoledronate as antiresorptive agent, respectively, and merely 26% of participants rightly marked teriparatide as an anabolic agent. This implies that participants had better knowledge

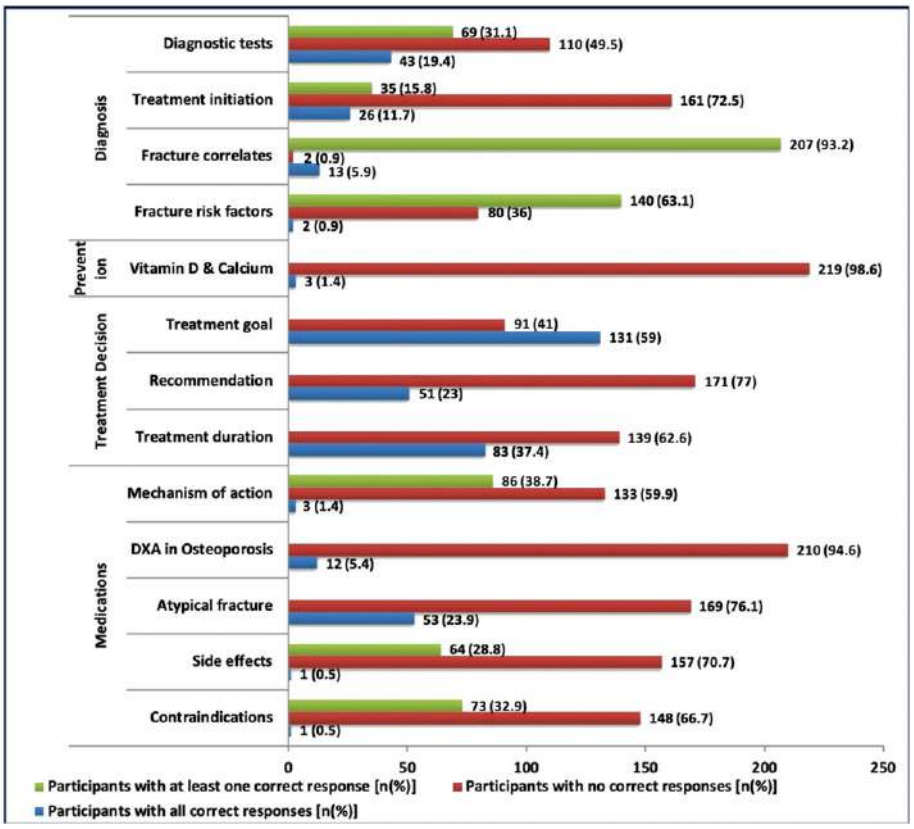


**FIGURE 1** Summary of responses of the participants

regarding bisphosphonates as compared with hormone replacement therapy, denosumab, and teriparatide. Barely 1.4% of participants were able to answer correctly all the options for the above-mentioned question. Sixty-eight percent of participants either did not answer or skipped at least one of the subsections of the question on side effects of osteoporosis medications. Surprisingly, only 2% of participants correctly answered that bisphosphonates, which are the most common agents used in the treatment of osteoporosis, should not be used if the estimated glomerular filtration rate (eGFR) was less than 35 mL/min.

Twenty-four percent of participants correctly answered that atypical fracture is subtrochanteric and is associated with prolonged use of bisphosphonates. The question on follow-up of a patient with osteoporosis using BMD measured by DXA scan was correctly answered by just 5% of the subjects.

## 5.5 | Sources of knowledge regarding osteoporosis

Professional literature, self-education, and expert lectures at CME's and conferences were rated as significant sources of knowledge regarding the approach, diagnosis, and treatment of osteoporosis by 40% and 30% of the participants, respectively. Thirty-four percent of participants answered that they had attended a lecture on osteoporosis in the last 2 years.

Only 4% of the participants rated their knowledge regarding osteoporosis as high, 46% each as intermediate and low, and 4% did not respond to the question.

## 5.6 | Barriers in management of patients with osteoporosis

Participants opined that financial constraints (41%), patient compliance towards medications (38%), and inadequate knowledge (22%) were significant factors that limited their ability to manage patients with osteoporosis. Other constraints reported were lack of effective diagnostic means (19%), time constraints (17%), bureaucratic difficulties (15%), side effects of medications (23%), and lack of trust in osteoporosis medications (27%).

## 5.7 | Differences in knowledge of participants about osteoporosis according to their professional and personal details

Participants aged less than 40 years (mean [SD] total score of 24.3 [9.3]%) had significantly more knowledge than those with age 40 years and above (mean [SD] total score of 20.9 [8.7]%; $P = .007$). Also, participants with experience of less than 10 years (mean [SD] total score of 24.7 [9.5]%) performed better ($P = .001$) as compared with those with experience of 10 years and above (mean [SD] total score of

20.4 [8.6]%). No significant difference was observed in the knowledge of male (mean [SD] total score of 21.6 [9.5]%) and female participants (mean [SD] total score of 23.8 [8.8]%; $P = .07$). There was also no difference in overall knowledge of graduate participants (mean [SD] total score of 23.0 [8.8]%) and internal medicine postgraduate (mean [SD] total score of 22.3 [10.1]%) participants ($P = .58$). These findings were based on the total score of questions 1 to 13 in the questionnaire obtained by the participants.

## 6 | DISCUSSION

This is the first study from India to evaluate the state of awareness of osteoporosis among medical practitioners at primary and secondary care levels. We observed that the mean total score (%) among them was 22.5%, which was quite low. Almost all of them had a score less than 50%. We also observed that participants with younger age (<40 years) and less experience (<10 years of practice) had better overall knowledge regarding osteoporosis and that there was no difference in knowledge with regard to sex of the general practitioners. Studies done in different parts of the world have reported inadequacy in knowledge level about osteoporosis among medical practitioners.[17-20]

Practitioners in this study displayed better knowledge regarding treatment decisions as compared with the knowledge of risk factors, diagnosis, and osteoporosis medications. This finding was consistent with a study by Fogelman et al.[17] Surprisingly, almost all of the practitioners were not able to answer the correct dose of calcium and vitamin D supplements.

As reported in previous studies,[18,19] physicians with younger age and less experience had better knowledge regarding osteoporosis, which may indicate the recent emphasis on osteoporosis in medical education. In contrast to an earlier study by Chenot et al,[20] which showed better knowledge scores among female practitioners, the present study showed no difference in overall knowledge between male and female practitioners. Surprisingly, contrary to what was expected, no difference was observed in knowledge of graduate and internal medicine postgraduates. This finding may indicate that the subject of osteoporosis has been given less importance in the medical curriculum even during postgraduate training.

Practitioners in the present study opined that financial constraints, patient educational level, and compliance with medications were significant barriers in the management of osteoporosis. As osteoporosis is one of the leading non-communicable causes of increased morbidity in the elderly, efforts should be made at the political and administrative levels to include osteoporosis in the national programme for non-communicable diseases. This will help in increasing awareness of the general population regarding osteoporosis and seeking timely treatment. Inclusion of osteoporosis in national programmes will help in subsidizing treatment costs. In addition, this will aid in overcoming the barriers imposed by poor educational status of patients and their financial constraints. Poor patient compliance towards osteoporosis medications can be tackled through community education regarding osteoporosis and its complications and also by periodic reinforcement of the same, by health care providers.[21]

The strengths of this study are that it is the first Indian study to assess physician awareness about osteoporosis with participation of about 78% of medical professionals who attended the CME during the study period. Limitations of this study include the lack of prior validation of the Fogelman's questionnaire in the Indian setting. Also, the study population may not be representative of medical professionals at primary, secondary, and tertiary care levels.

To summarize, significant lacunae were identified in knowledge and awareness pertaining to osteoporosis. These gaps were chiefly identified in the domains of risk factors and diagnosis of osteoporosis, medications used to treat the same, and the dose of calcium and vitamin D supplements. Age and experience seemed to be inversely related to scores obtained in the questionnaire. Such inadequacy in knowledge may be addressed only through medical updates and CME programmes. Tertiary care centres that actively screen for and treat osteoporosis ought to take adequate initiative in conducting the requisite number of CMEs and catering to smaller health care centres and general practitioners that come within its purview. This will serve to enhance their knowledge and broaden their perspective of this condition.

In conclusion, this study stipulates the need for escalating the efforts to improve the knowledge of primary and secondary care practitioners, as well as to give more attention in medical education both at graduate and postgraduate levels, regarding various aspects of osteoporosis management.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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