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Clinical effectiveness, safety, and adherence to calcium and vitamin d supplementation in postmenopausal women and diabetic patients: A cross-sectional survey of last 10 cases

Pranay Swarnkar[1*], Brij Mohan Chaudhary[2], J Khaja Moinudeen[3], Leela Mohan P V R[4], Ramesh Dodabhangi[5]
[1] Consultant Physician, Prabha Clinic, Ghaziabad, Uttar Pradesh, India
[2] Consultant Physician, Chaudhary Poly Clinic, Sahibabaad, Ghaziabad, Uttar Pradesh, India
[3] Consultant Physician, Fathima Hospitals Multispeciality Center, Coimbatore, Tamilnadu, India
[4] Consultant Physician, Adithem HealthCare, Bengaluru, Karnataka, India
[5] Consultant Physician, Vivekananda Hospital, Sankeshwar, Chikodi, Karnataka, India
Corresponding Author: Pranay Swarnkar

Abstract
Background: Calcium and vitamin D are key nutrients for maintaining bone health and metabolic stability, particularly in groups prone to bone fragility such as postmenopausal women and people with diabetes. Therefore, the study aimed to evaluate the effectiveness, safety, and adherence to calcium and vitamin D supplementation postmenopausal women and diabetic patients.
Methods: This questionnaire-based study collected responses from healthcare practitioners (HCPs) in India regarding their last 10 patients who received calcium and vitamin D supplementation. The survey assessed presenting symptoms, time to improvement, clinical effectiveness, safety, side effects, discontinuation, adherence, need for additional therapies, drug interactions, prescribing practices, patient concerns, and monitoring patterns.
Results: A total of 128 HCPs were included in this study. About 35.94% of HCPs reported symptomatic improvement within 2–4 weeks after starting calcium and vitamin D supplementation, and 45.31% rated the efficacy in preventing osteoporosis-related complications as "good" (51–75% risk reduction). Most HCPs (43.75%) reported a moderate improvement in glycemic control with calcium and vitamin D supplementation. Around 35.94% of HCPs reported that calcium and vitamin D supplementation was more effective than other bone health interventions. In the last 10 patient experiences, 49.22% of HCPs reported good adherence (76–90% of doses taken) to calcium and vitamin D supplementation. Around 45.31% of HCPs agreed that calcium and vitamin D supplementation should be considered a first-line therapy for osteoporosis prevention in postmenopausal women and diabetic patients.
Conclusion: Calcium and vitamin D supplementation is generally effective, well-tolerated, and widely accepted in clinical practice for postmenopausal women and diabetic patients.

Keywords: Cost-effectiveness, healthcare practitioners, osteoporosis, questionnaire-based

Introduction
Menopause refers to the permanent end of menstrual cycles, and it is confirmed only after a woman has gone 12 consecutive months without a period. Most women experience menopause between 49 and 52 years of age, with the average age in the United States being around 51 years. Approximately 1.5 million women go through the menopausal transition every year [1]. Type 2 diabetes mellitus is a significant global health concern, with its incidence steadily increasing across the world [2]. The growing prevalence of diabetes in India among various sociodemographic groups poses a significant challenge to public health and the healthcare system as a whole [3].
Calcium and vitamin D are fundamental for bone health, bone remodeling, and maintenance of mineral homeostasis. Vitamin D facilitates the intestinal absorption of calcium and phosphorus, which are crucial for bone mineralization; without sufficient vitamin D, calcium absorption drops significantly, increasing the risk of bone disorders [4]. In postmenopausal women, the decline in estrogen levels accelerates bone resorption and predisposes to loss of bone mineral density (BMD), osteoporosis, and fractures. Supplementation with calcium and vitamin D has long been recommended as a preventative or adjunctive strategy to slow postmenopausal bone loss [5]. Combined calcium and vitamin D supplementation is best viewed as supportive nutritional therapy and is often used alongside other osteoporosis treatments, rather than being relied upon as a definitive standalone strategy for preventing fractures [6].
In individuals with either type 1 or type 2 diabetes, bone health is further weakened due to metabolic abnormalities, disrupted calcium regulation, and the frequent presence of vitamin D deficiency [4]. Experimental and epidemiologic studies suggest that calcium and vitamin D may reduce the risk of developing diabetes. In animal-experimental studies, administration of calcium and vitamin D improved pancreatic (β-cell function and peripheral insulin sensitivity) [7]. Regarding the effectiveness of calcium and vitamin D, meta-analyses demonstrate that combined supplementation provides modest improvements in BMD and can reduce hip fracture risk by approximately 10–15%, especially among individuals with inadequate dietary intake or significant deficiency [8].
In this regard, the rationale of the study was to understand the real-world clinical effectiveness, safety, and prescribing practices of calcium and vitamin D supplementation in postmenopausal women and diabetic patients. Therefore, the study aimed to evaluate the effectiveness, safety, and adherence to calcium and vitamin D supplementation in these patient groups, based on insights from the last 10 cases.

Methods

Study design

This questionnaire-based study was conducted among Indian HCPs. Participation in the study was entirely voluntary, and both the study procedures and data analysis were designed to maintain the confidentiality and anonymity of all participating HCPs.

Study questionnaire

The study questionnaire was developed based on existing literature, clinical guidelines, and expert opinions. It included a total of 36 questions, of which 25 questions specifically focused on HCPs experiences with calcium and vitamin D supplementation. These questions addressed presenting symptoms, speed of improvement, overall efficacy, side effects, adherence, and comparisons with other therapies. They also explored prescribing factors, osteoporosis risk factors, effective patient groups, drug interactions, preferred formulations, monitoring practices, reasons for discontinuation, patient concerns, adherence-enhancing strategies, dose adjustments, and the occurrence of hypercalcemia. The study protocol was approved by the independent ethics committee in accordance with the principles of GCP.

Inclusion and exclusion criteria

Healthcare practitioners who have managed at least the last 10 patients receiving calcium and vitamin D supplementation for bone health, including postmenopausal women and diabetic patients, and who can provide real-world insights on symptoms, efficacy, safety, adherence, and clinical outcomes. Patients with shorter treatment duration, minimal exposure to therapy, or lacking complete clinical information were excluded from the study.

Data collection

Healthcare practitioners received a brief explanation of the study and instructions for completing the questionnaire. The questionnaire was given to the HCPs either in person, via phone calls, or through online platforms, as per the HCP's convenience.

Data analysis

The responses of HCPs were entered into Microsoft Excel and descriptive statistics, such as frequencies and percentages, were employed to present data.

Results

A total of 128 HCPs were included in this study. Based on their last 10 patients' experience, 47.66% of HCPs reported that a combination of all listed symptoms was the most common presenting feature before initiating calcium and vitamin D supplementation. This was followed by frequent fractures and poor wound healing (30.47%), fatigue and generalized weakness (15.63%), and bone pain with muscle weakness (6.25%). Approximately 35.94% of HCPs reported that patients typically show symptomatic improvement within 2–4 weeks after starting calcium and vitamin D supplementation. Significant improvement in musculoskeletal symptoms following calcium and vitamin D supplementation in postmenopausal women and diabetic patients was reported by 42.97% of HCPs. Based on the last patient experience, 45.31% of HCPs reported that the overall efficacy of calcium and vitamin D supplementation in preventing osteoporosis-related complications was 'good efficacy' (51–75% risk reduction). Most HCPs (43.75%) reported a moderate improvement in glycemic control with calcium and vitamin D supplementation. Among the last 10 patient experiences, 25.78% of HCPs reported that 1–2 patients experienced side effects from calcium and vitamin D supplementation, 10.94% reported that 3–5 patients experienced side effects, 4.69% reported that more than 5 patients experienced side effects, and 58.59% reported that none of the patients experienced side effects. Around 35.94% of HCPs reported that calcium and vitamin D supplementation was more effective than other bone health interventions. In the last 10 patient experiences, 49.22% of HCPs reported good adherence (76–90% of doses taken) to calcium and vitamin D supplementation (Table 1).

Table 1: Clinical Effectiveness, Symptom Profile, and Safety of Calcium and Vitamin D Supplementation (N = 128)

Questions	Options	Response (N=128)
Based on your last 10 patients experience, what was the most common presenting symptom before starting Calcium and Vitamin D supplementation?	Combination of all the above	61 (47.66)
	Frequent fractures and poor wound healing	39 (30.47)
	Fatigue and generalized weakness	20 (15.63)
	Bone pain and muscle weakness	8 (6.25)
How soon did patients report symptomatic improvement after starting Calcium and Vitamin D supplementation?	Within 1 week	29 (22.66)
	2–4 weeks	46 (35.94)
	1–3 months	40 (31.25)
	No significant improvement Fever	13 (10.66)
How effective was Calcium and Vitamin D supplementation in improving musculoskeletal symptoms in postmenopausal women and diabetic patients?	Complete resolution	38 (29.69)
	Significant improvement	55 (42.97)
	Moderate improvement	26 (20.31)
	Poor improvement	9 (7.03)
Based on your last 10 patients, what was the overall efficacy of Calcium and Vitamin D supplementation in preventing osteoporosis-related complications?	Excellent efficacy (>75% risk reduction)	48 (37.50)
	Good efficacy (51–75% risk reduction)	58 (45.31)
	Moderate efficacy (25–50% risk reduction)	18 (14.06)
	Poor efficacy (<25% risk reduction)	4 (3.13)
How did Calcium and Vitamin D supplementation affect glycemic control in diabetic patients?	Significant improvement	27 (21.09)
	Moderate improvement	56 (43.75)
	Mild improvement	35 (27.34)
	No improvement	10 (7.81)
What was the most commonly reported side effect of Calcium and Vitamin D supplementation in your last 10 patients?	None	75 (58.59)
	1-2 patients	33 (25.78)
	3-5 patients	14 (10.94)

	>5 patients	6 (4.69)
In comparison to other bone health interventions (e.g., bisphosphonates, selective estrogen receptor modulators), how effective was Calcium and Vitamin D supplementation in your patients?	Significantly more effective	23 (17.97)
	More effective	46 (35.94)
	Equally effective	41 (32.03)
	Less effective	18 (14.06)
What was the level of adherence to Calcium and Vitamin D supplementation among your last 10 patients?	Excellent adherence (>90% doses taken)	29 (22.66)
	Good adherence (76–90% doses taken)	63 (49.22)
	Moderate adherence (50–75% doses taken)	27 (21.09)
	Poor adherence (<50% doses taken)	9 (7.03)
Data presented as n (%).		

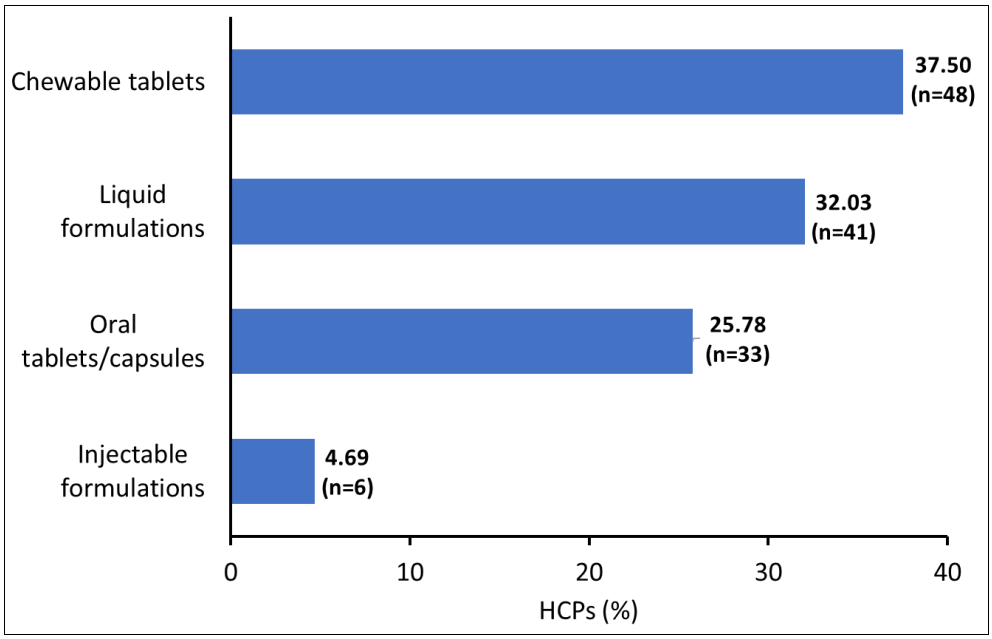
Additionally, 39.06% of HCPs reported that 1–3 patients required additional medications (e.g., bisphosphonates, hormone therapy) despite being on calcium and vitamin D supplementation. Around 45.31% of HCPs agreed that calcium and vitamin D supplementation should be considered a first-line therapy for osteoporosis prevention in postmenopausal women and diabetic patients. Cost-effectiveness was the most important factor influencing the decision to prescribe calcium and vitamin D supplementation, as reported by 34.38% of HCPs. Based on the last 10 patients, 37.50% of HCPs reported that a sedentary lifestyle was the most common risk factor for osteoporosis in postmenopausal women and diabetic patients. Calcium and vitamin D supplementation was reported to be most effective in elderly patients with multiple fracture risk factors, as noted by 36.72% of HCPs. Around 36.72% of HCPs reported that the need for long-term use was the most significant limitation of calcium and vitamin D supplementation in clinical practice. Additionally, 33.59% of HCPs reported that they did not observe any major drug interactions with calcium and vitamin D supplementation in the last 10 patients. Based on the last 10 patient experiences, 38.28% of HCPs reported that patient education on adherence and risk factors would improve the effectiveness of calcium and vitamin D supplementation in managing osteoporosis and diabetes-related bone health issues. Most HCPs (37.50%) preferred chewable tablets as the mode of calcium and vitamin D supplementation (Figure 1). Monitoring serum calcium and vitamin D levels every 3 months or every 6 months in patients receiving supplementation was reported by 24.22% of HCPs. Based on the last 10 patients, 32.81% of HCPs reported that concerns about long-term safety were the most common reason for discontinuation of calcium and vitamin D supplementation. The cost of long-term therapy was the most common patient concern regarding calcium and vitamin D supplementation, as reported by 35.94% of HCPs. Around, 34.38% of HCPs reported that patient education and counselling was the most effective strategy to enhance adherence to calcium and vitamin D supplementation. Most HCPs (36.72%) reported that no patients required dose adjustments for calcium and vitamin D supplementation. Meanwhile, 31.25% reported adjustments in 1–3 patients, 20.31% in 4–6 patients, and 11.72% in more than 6 patients. Around, 34.38% of HCPs reported that they rarely encounter patients with hypercalcemia caused by excessive calcium and vitamin D supplementation (Table 2). Activated vitamin D (Calcitriol) was considered the most effective form of vitamin D supplementation in postmenopausal women and diabetic patients, as reported by 30.47% of HCPs (Figure 2).

Table 2: Prescribing Practices, Risk Factors, Patient Concerns, and Monitoring Patterns for Calcium and Vitamin D Supplementation (N = 128)

Questions	Options	Response (N=128)
How many of your last 10 patients required additional medications (e.g., bisphosphonates, hormone therapy) despite being on Calcium and Vitamin D supplementation?	None	39 (30.47)
	1-3 patients	50 (39.06)
	4-6 patients	27 (21.09)
	>6 patients	12 (9.38)
Do you believe Calcium and Vitamin D supplementation should be considered a first-line therapy for osteoporosis prevention in postmenopausal women and diabetic patients?	Strongly agree	39 (30.47)
	Agree	58 (45.31)
	Disagree	17 (13.28)
	Strongly disagree	14 (10.94)
What is the most important factor influencing your decision to prescribe Calcium and Vitamin D supplementation?	Cost-effectiveness	44 (34.38)
	Patient preference and adherence	32 (25.00)
	Risk of osteoporosis and fractures	28 (21.88)
	Guidelines and clinical evidence	24 (18.75)
Based on your last 10 patients, what is the most common risk factor for osteoporosis in postmenopausal women and diabetic patients?	Sedentary lifestyle	48 (37.50)
	Multiple risk factors	37 (28.91)
	Vitamin D deficiency	24 (18.75)
	Poor dietary calcium intake	19 (14.84)
In which group of patients is Calcium and Vitamin D supplementation most effective?	Elderly patients with multiple risk factors for fractures	47 (36.72)
	Postmenopausal women with early-stage osteoporosis	35 (27.34)
	Diabetic patients with vitamin D deficiency	27 (21.09)
	Equally effective in all groups	19 (14.84)
What is the most significant limitation of Calcium and Vitamin D supplementation in clinical practice?	Need for long-term use	47 (36.72)
	Limited efficacy in advanced osteoporosis	28 (21.88)

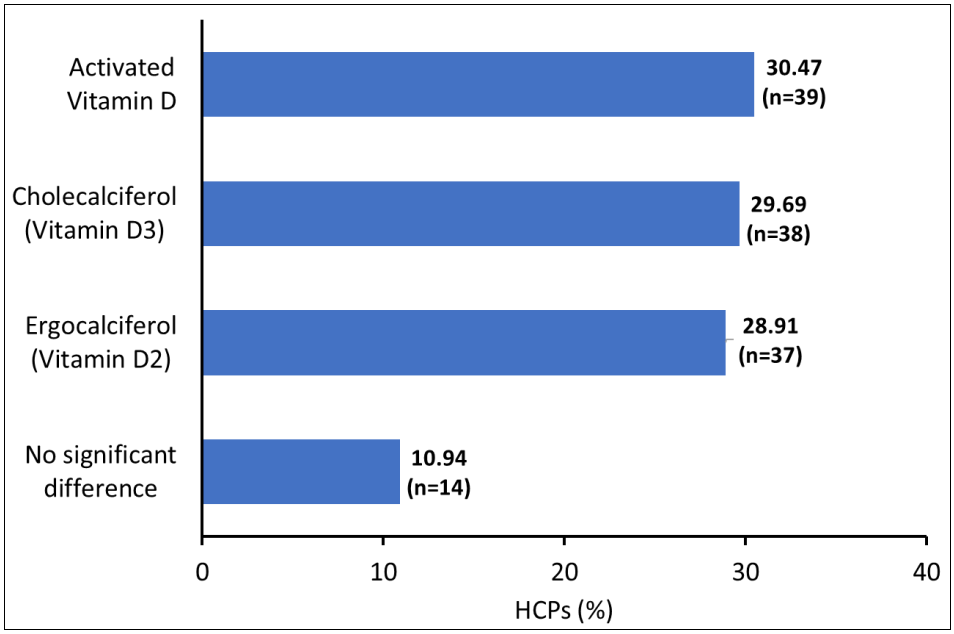
	Cost and availability	27 (21.09)
	Potential for adverse effects (e.g., kidney stones, hypercalcemia)	26 (20.31)
Have you observed any significant drug interactions with Calcium and Vitamin D supplementation in your last 10 patients?	No major interactions	43 (33.59)
	Reduced efficacy when combined with certain antibiotics (e.g., tetracyclines)	40 (31.25)
	Reduced absorption with PPIs	35 (27.34)
	Increased risk of hypercalcemia with thiazide diuretics Good	10 (7.81)
Based on your last 10 patients, what would improve the effectiveness of Calcium and Vitamin D supplementation in managing osteoporosis and diabetes-related bone health issues?	Patient education on adherence and risk factors	49 (38.28)
	Combination with lifestyle modifications (e.g., exercise, diet)	22 (17.19)
	Earlier initiation of therapy	6 (4.69)
	All of the above	51 (39.84)
	No significant difference	14 (10.94)
How frequently do you monitor serum calcium and Vitamin D levels in patients receiving supplementation?	Every 3 months	31 (24.22)
	Every 6 months	31 (24.22)
	Annually	41 (32.03)
	Only when clinically indicated	25 (19.53)
Based on your last 10 patients, what is the most common reason for discontinuation of Calcium and Vitamin D supplementation in your patients?	Concerns about long-term safety	42 (32.81)
	Lack of symptomatic improvement	35 (27.34)
	Gastrointestinal intolerance	32 (25.00)
	Poor adherence to therapy	19 (14.84)
What is the most common patient concern regarding Calcium and Vitamin D supplementation?	Cost of long-term therapy	46 (35.94)
	Perceived lack of benefit	30 (23.44)
	Fear of kidney stones	29 (22.66)
	Difficulty in adherence to daily supplementation	23 (17.97)
What is the most effective strategy to enhance adherence to Calcium and Vitamin D supplementation?	Patient education and counseling	44 (34.38)
	Combining supplementation with routine medications	33 (25.78)
	Simplifying dosing regimen	29 (22.66)
	Regular follow-ups and monitoring	22 (17.19)
What percentage of your patients required dose adjustments for Calcium and Vitamin D supplementation due to side effects?	None	47 (36.72)
	1–3 patients	40 (31.25)
	4–6 patients	26 (20.31)
	>6 patients	15 (11.72)
How often do you encounter these 10 patients with hypercalcemia due to excessive Calcium and Vitamin D supplementation?	Frequently (>5 patients per year)	10 (7.81)
	Occasionally (3–5 patients per year)	36 (28.13)
	Rarely (1–2 patients per year)	44 (34.38)
	Never	38 (29.69)

Data presented as n (%).
PPI, proton pump inhibitors.



HCPs, healthcare professionals.

Fig 1: Preferred mode of calcium and vitamin D supplementation



HCPs, healthcare professionals

Fig 2: Most Effective Form of Vitamin D Supplementation

Discussion

Calcium and vitamin D are vital nutrients for maintaining strong bones, especially in groups at higher risk of bone loss, such as postmenopausal women and people with diabetes. In postmenopausal women, decreased estrogen levels accelerate bone breakdown, raising the likelihood of osteoporosis and fractures. Similarly, individuals with diabetes particularly T2DM often experience changes in bone metabolism, reduced bone quality, and a higher risk of fractures, influenced by chronic high blood sugar, insulin resistance, and related health conditions [9]. This questionnaire-based study evaluated HCPs perceptions regarding the clinical effectiveness safety, and adherence to calcium and vitamin D supplementation in postmenopausal women and diabetic patients' groups based on last 10 cases.

In the present study, nearly half of HCPs (47.66%) reported that a combination of all listed symptoms (presumably bone pain, muscle weakness, fractures, poor wound healing, fatigue etc.) was the most common presentation before initiating calcium + vitamin D supplementation. These findings are consistent with the typical signs of vitamin D and calcium deficiencies, such as muscle weakness, bone discomfort, fractures, and delayed healing. Insufficient vitamin D is well known to contribute to muscle cramps or weakness, bone pain, and a heightened risk of fractures [10]. Approximately 36% of HCPs observed symptomatic improvement within 2–4 weeks after starting calcium and vitamin D supplementation. A similar observation was reported in the study by Goyal V *et al* [11]. In the present study, nearly half of the HCPs rated the overall effectiveness of calcium and vitamin D supplementation in reducing osteoporosis-related complications as "good." Similarly, findings from Cong B. *et al*. demonstrated that combining calcium with vitamin D can enhance pelvic BMD and correct deficient serum 25(OH)D levels in postmenopausal women with osteoporosis [6].

The study by Mehta S. *et al*. reported that in patients with T2DM, a 12-week supplementation of vitamin D and calcium in addition to standard oral antidiabetic therapy led to a significant reduction in HbA1c levels compared with patients who did not receive the supplements [12]. These findings are consistent with the results of the current study, in which 43.75% of healthcare professionals reported observing a moderate improvement in glycemic control with calcium and vitamin D supplementation.

In the present study, 45.3% of HCPs consider calcium and vitamin D supplementation as first-line therapy for osteoporosis prevention in postmenopausal women and diabetic patients. Calcium and vitamin D supplements should not be used as the primary treatment for preventing osteoporosis in all postmenopausal or diabetic patients; instead, they serve as an essential initial measure to address deficiencies and maintain general bone health [13]. Meta-analyses evidence shows that calcium supplements can lower the risk of non-vertebral fractures, and this protective effect becomes stronger when calcium is taken together with vitamin D, especially in reducing hip fracture risk [13]. In the current study, 34.38% of HCPs indicated that cost-effectiveness is the primary factor influencing their decision to prescribe calcium and vitamin D. This aligns with the fact that these supplements are comparatively inexpensive relative to other osteoporosis therapies [14]. The study indicate that calcium and vitamin D supplementation is widely viewed by HCPs as an effective, well-tolerated, and cost-efficient approach for improving musculoskeletal symptoms and supporting osteoporosis prevention in postmenopausal women and diabetic patients.

The study has several limitations. The relatively small sample size may restrict the generalizability of the findings, as the responses may not fully represent the broader population of HCPs. Additionally, the use of a self-reported questionnaire introduces the potential for response bias. Therefore, these limitations should be considered before drawing conclusions from the results.

Conclusion

The study highlights the calcium and vitamin D supplementation is generally effective, well-tolerated, and widely accepted in clinical practice for postmenopausal women and diabetic patients. Most HCPs observed

meaningful improvement in musculoskeletal symptoms, good overall efficacy in reducing osteoporosis-related risks, and favourable patient adherence. Side effects were infrequent, and major drug interactions were rarely reported. Overall, the data support the use of calcium and vitamin D supplementation as a first-line strategy for improving bone health and preventing osteoporosis in high-risk populations.

Conflict of interest: All authors have no conflict of interest to declare.

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