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VITAMIN D DEFICIENCY IN ADULT WOMEN IN INDIAN PRIMARY CARE: CLINICAL PRESENTATION, RISK FACTORS AND RATIONAL THERAPEUTIC MANAGEMENT — A NARRATIVE REVIEW

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Abstract
Vitamin D deficiency is a common yet frequently under-recognised clinical problem among adult women, particularly in primary care settings. Although vitamin D is best known for its role in calcium absorption, bone mineralisation and prevention of osteomalacia, its clinical relevance also extends to muscle function, falls, frailty, pregnancy, lactation and postmenopausal bone health. Women often present with nonspecific symptoms such as fatigue, diffuse body pain, low backache, leg pain, cramps, proximal muscle weakness and reduced physical confidence. These complaints may be wrongly attributed to ageing, stress, anaemia, thyroid disease, menopause or lifestyle strain. Adult women are vulnerable because of limited sunlight exposure, darker skin pigmentation, indoor lifestyle, vegetarian dietary habits, obesity, pregnancy, lactation, menopause, ageing, malabsorption and long-term use of certain medicines. In India, vitamin D deficiency remains widely reported despite abundant sunlight, reflecting the combined impact of urbanisation, pollution, clothing patterns, diet and low food fortification. This narrative review discusses the clinical presentation, risk factors, diagnostic approach, pharmacology and therapeutic management of vitamin D deficiency in adult women. A rational primary care strategy should focus on targeted testing, appropriate vitamin D3 supplementation, calcium and diet assessment, safe sunlight exposure, exercise, monitoring and avoidance of unnecessary prolonged high-dose therapy.

Keywords: Vitamin D deficiency; adult women; primary care; vitamin D3; menopause; India.

Introduction

Vitamin D deficiency is a quiet clinical disorder with a wide human footprint. In daily primary care, a woman may not present with the words “vitamin D deficiency.” She may instead say, “I am always tired,” “My legs pain,” “My back feels weak,” or “I cannot climb stairs comfortably.” These symptoms are common, subtle and easily dismissed as routine stress, ageing, domestic workload, menopause or lack of rest. Yet vitamin D deficiency may be an important and correctable contributor in many such patients.[1,2]

Vitamin D is a fat-soluble vitamin and prohormone essential for calcium and phosphate homeostasis, bone mineralisation and normal muscle function.[1] Deficiency may lead to secondary hyperparathyroidism, bone demineralisation, osteomalacia, osteoporosis, proximal myopathy, falls

and fractures in vulnerable individuals.[1,4] Although several extra-skeletal effects of vitamin D have been explored, the strongest established clinical role remains musculoskeletal health.[1,2]

Adult women deserve special attention because their bone and mineral health changes across life stages. Pregnancy and lactation increase nutritional needs, while menopause accelerates bone loss because of estrogen decline. Elderly women may additionally have reduced outdoor exposure, poor diet, chronic illness, polypharmacy and higher fall risk.[2,3] Therefore, vitamin D deficiency in women is not merely a laboratory abnormality; it is connected with mobility, independence, pregnancy, ageing and quality of life.

This review aims to provide a practical primary care framework for recognising, investigating and managing vitamin D deficiency in adult women, with special attention to the Indian context and rational therapeutic use.

Methods

This is a narrative review based on published literature, clinical guidelines and public health resources. Literature was identified through PubMed, Google Scholar, guideline documents and official medical resources. Priority was given to publications discussing vitamin D physiology, Indian prevalence, women's health, risk factors, screening, vitamin D2 and D3 pharmacology, supplementation, toxicity and monitoring. Major sources included guidance from the National Institutes of Health Office of Dietary Supplements, Endocrine Society recommendations, USPSTF screening guidance, Indian prevalence reviews and peer-reviewed studies on vitamin D supplementation.[1–10]

Vitamin D Physiology and Pharmacology

Vitamin D is obtained through cutaneous synthesis and dietary intake. Ultraviolet B radiation converts 7-dehydrocholesterol in the skin into previtamin D3, which is then converted to vitamin D3 or cholecalciferol.[1,11] Smaller amounts are obtained from foods such as fatty fish, egg yolk, liver, fortified milk, fortified cereals and supplements. Mushrooms exposed to ultraviolet light may provide vitamin D2 or ergocalciferol.[1]

Both vitamin D2 and vitamin D3 are biologically inactive and require hydroxylation. The liver converts them to 25-hydroxyvitamin D [25(OH)D], the main circulating marker used to assess vitamin D status. The kidney then converts 25(OH)D to 1,25-dihydroxyvitamin D, the active hormonal form.[1] Serum 25(OH)D is preferred for assessment because it reflects vitamin D from sunlight, food and supplements, whereas 1,25-dihydroxyvitamin D is tightly regulated and may remain normal until deficiency is severe.[1]

From a clinical pharmacology perspective, vitamin D3 is generally preferred for supplementation because meta-analysis has shown it raises serum 25(OH)D more effectively than vitamin D2, particularly when given as intermittent bolus therapy.[8] Absorption occurs in the small intestine and is enhanced by dietary fat, although some absorption occurs even without fat.[1] Certain drugs can reduce vitamin D status or interfere with metabolism, including anticonvulsants, glucocorticoids, rifampicin, antiretroviral therapy, orlistat and bile acid sequestrants.[1,4] Patients on such medicines require closer clinical attention.

Indian and Female-Specific Risk Factors

India presents a striking "sunshine paradox": abundant sunlight coexists with widespread vitamin D deficiency. Indian reviews have reported high prevalence across age groups, regions and socioeconomic backgrounds, with many studies showing deficiency in a large proportion of the population.[5,6] A South Asian systematic review also reported high deficiency prevalence, with women often more affected than men.[7]

Adult women are vulnerable because of a combination of biological, cultural, nutritional and environmental factors. Indoor work, urban housing, safety concerns, air pollution, covered clothing and limited recreational outdoor activity reduce ultraviolet exposure.[5,11] Darker skin pigmentation

decreases vitamin D synthesis because melanin absorbs ultraviolet radiation.[1,11] Vegetarian dietary patterns may further reduce intake because natural vitamin D-rich foods are limited.[1,5]
Pregnancy and lactation increase the importance of adequate vitamin D and calcium status. Menopause is another critical stage because accelerated bone loss may coexist with low calcium intake, sedentary lifestyle and vitamin D deficiency.[2,12] Obesity is also relevant because vitamin D may be sequestered in adipose tissue, leading to lower circulating levels.[1] Chronic kidney disease, chronic liver disease, malabsorption, bariatric surgery and long-term steroid or anticonvulsant therapy further increase risk.[1,4]

Clinical Presentation

Vitamin D deficiency may be asymptomatic or may present with nonspecific complaints. Common symptoms include fatigue, diffuse body ache, low back pain, leg pain, muscle cramps, proximal muscle weakness, heaviness while walking and difficulty climbing stairs.[4,9] Some women describe a deep “bone pain” or persistent weakness that does not match ordinary tiredness.
In severe deficiency, osteomalacia may occur, presenting with bone tenderness, waddling gait, proximal myopathy and increased fracture risk.[1,4] In older women, deficiency may contribute to poor balance, frailty and falls, although supplementation benefits are clearer in deficient or high-risk individuals than in generally healthy adults not selected for deficiency.[9,10]
The diagnostic difficulty is that symptoms overlap with anaemia, hypothyroidism, depression, fibromyalgia, inflammatory arthritis, menopause-related symptoms and chronic fatigue. Therefore, vitamin D deficiency should be considered in context and not diagnosed on symptoms alone.

Diagnostic Approach in Primary Care

Serum 25(OH)D is the preferred laboratory test for assessing vitamin D status.[1] However, routine screening of every asymptomatic adult is not recommended. USPSTF states that evidence is insufficient to assess the balance of benefits and harms of screening asymptomatic, community-dwelling, nonpregnant adults.[3] The Endocrine Society 2024 guidance also discourages routine 25(OH)D testing in people without established indications.[2]
A primary care physician should therefore use targeted testing. Testing is reasonable in women with persistent musculoskeletal pain, proximal weakness, recurrent falls, low-trauma fracture, osteoporosis, malabsorption, chronic kidney or liver disease, long-term steroid or anticonvulsant use, pregnancy with risk factors, postmenopausal bone concerns or poor response to usual musculoskeletal treatment.[1–4]
Laboratory thresholds vary. Many clinical settings define deficiency as 25(OH)D below 20 ng/mL, insufficiency as 20–30 ng/mL and sufficiency above 30 ng/mL, though cut-offs differ between guidelines and laboratories.[1,4] Results should be interpreted with symptoms, risk factors, calcium, phosphate, alkaline phosphatase, parathyroid hormone where indicated and overall clinical judgement.

Therapeutic Management

Treatment should correct deficiency, improve musculoskeletal function, prevent recurrence and avoid toxicity. Vitamin D3 is commonly preferred because of better efficacy in raising serum 25(OH)D.[8] For confirmed deficiency, short-term repletion followed by maintenance therapy is commonly used.[4] Exact dosing should be individualised according to baseline 25(OH)D level, symptoms, age, pregnancy status, obesity, malabsorption, comorbidities and local protocol.
Calcium intake must be assessed because vitamin D supports calcium absorption and bone health.[1,12] Dietary sources include milk, curd, paneer, fortified foods, ragi, sesame seeds, leafy greens and other culturally acceptable options. Calcium supplements may be considered when dietary intake is inadequate, especially in postmenopausal women or those with osteoporosis risk, but unnecessary excessive supplementation should be avoided.[1,12]

Sunlight exposure should be advised realistically. Time of day, season, cloud cover, pollution, skin pigmentation, clothing and sunscreen all influence vitamin D synthesis.[1,11] Exercise is equally important. Walking, stair climbing, yoga, resistance training and balance exercises support strength, posture, bone health and fall prevention.

Table 1. Common Risk Factors for Vitamin D Deficiency in Adult Women

Category	Risk factors
Lifestyle	Indoor work, low sunlight exposure, sedentary routine
Environmental	Air pollution, urban housing, limited open spaces
Personal	Darker skin, covered clothing, sunscreen use
Nutritional	Vegetarian diet, low fortified food intake, low calcium intake
Life stage	Pregnancy, lactation, menopause, elderly age
Medical	Obesity, chronic kidney disease, liver disease, malabsorption
Drug-related	Steroids, anticonvulsants, rifampicin, orlistat, bile acid sequestrants
Bone-related	Osteoporosis, low-trauma fracture, recurrent falls

Table 2. Practical Dosing, Monitoring and Toxicity Framework

Clinical situation	Practical approach
Suspected deficiency with risk factors	Test serum 25(OH)D where available; also consider calcium, phosphate, alkaline phosphatase and renal function
Confirmed deficiency	Use vitamin D3 repletion as per local protocol; older guidance commonly used 50,000 IU weekly for 8 weeks or equivalent under supervision
Maintenance after correction	Use lower maintenance dosing, commonly daily/weekly dosing depending on adherence and clinician judgement
Obesity or malabsorption	May need higher or longer therapy with closer monitoring
Pregnancy/lactation	Avoid unsupervised high-dose therapy; follow obstetric/clinical guidance
Monitoring	Reassess symptoms, adherence, calcium intake and repeat 25(OH)D when clinically required
Toxicity warning	Avoid repeated high-dose sachets/injections without monitoring
Toxicity features	Hypercalcaemia, nausea, vomiting, constipation, weakness, polyuria, confusion, renal stones or renal injury

Avoiding Overtreatment

Vitamin D is useful when deficiency is present, but more is not always better. Excessive supplementation can cause hypercalcaemia, hypercalciuria, renal stones, soft tissue calcification, renal failure, arrhythmias and rarely death.[1] Toxicity is usually caused by excessive supplement intake, incorrect prescription or prolonged high-dose therapy, not ordinary sunlight exposure.[1]

This is important in Indian practice, where patients may repeatedly take high-dose sachets or injections without testing or review. Primary care physicians should discourage self-medication and explain that vitamin D is a therapy, not a harmless energy tonic.

Discussion

Vitamin D deficiency in adult women demands a balanced approach. Ignoring it may leave patients with persistent pain, weakness, osteomalacia, falls or reduced quality of life. Over-medicalising it may lead to unnecessary testing, cost and unsafe supplementation. The best strategy lies between these extremes: identify high-risk women, test when indicated, treat rationally and monitor sensibly.

The role of the primary care physician is crucial. A family doctor often understands the patient's diet, clothing habits, work pattern, affordability, family responsibilities and treatment adherence better than a specialist seeing her once. This allows counselling to be personalised. For example, a woman who works indoors may need different advice than an elderly postmenopausal woman with osteoporosis or a pregnant woman with dietary restrictions.

The public health message should also be careful. India has sunshine, but sunshine alone does not guarantee vitamin D sufficiency. Pollution, indoor life, darker skin, clothing and low dietary fortification all matter.[5,6,11] Prevention should include food fortification, nutrition counselling, women-centred health education, safe sun exposure and targeted supplementation for high-risk groups.

Conclusion

Vitamin D deficiency is common among adult women and often presents through nonspecific symptoms such as fatigue, diffuse body ache, low back pain, cramps and weakness. Women are especially vulnerable because of limited sunlight exposure, dietary patterns, pregnancy, lactation, menopause, ageing, obesity, chronic disease and interacting medicines. Primary care management should be rational and patient-centred: targeted testing, vitamin D3 supplementation when indicated, adequate calcium intake, sensible sunlight exposure, exercise, monitoring and avoidance of prolonged unsupervised high-dose therapy. The aim is not merely to correct a laboratory value, but to preserve strength, mobility, bone health and dignity across a woman's life course.

Declarations

Ethics approval: Not applicable, as this is a narrative review based on previously published literature and does not involve human participants or patient records.

Consent: Not applicable.

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