

CMEARTICLE

Vitamin D deficiency

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Madam Fatimah walked into your consultation room with the aid of a single point stick. She was there for a review following a left hip fracture that was treated surgically with open reduction and internal fixation 12 weeks ago. You reviewed her hospital records through your National Electronic Health Record account and noted that her last serum 25-hydroxyvitamin D [25(OH)D] test, which had been done in hospital, had found a 25(OH)D level of < 5 µg/mL with normal calcium levels and kidney function. You noted that she was started on the bisphosphonate Fosamax at 70 mg/wk.

HOW COMMON IS THIS IN MY PRACTICE?

Vitamin D deficiency in the elderly population

Vitamin D deficiency is common among elderly patients in temperate countries, especially in early spring due to reduced cutaneous synthesis during the winter months,^(1,2) and in housebound individuals⁽³⁾ and medical inpatients.⁽⁴⁾ The prevalence of vitamin D deficiency is even higher in elderly patients with fragility fractures, ranging from 55%–91.6%.⁽⁵⁻⁷⁾ A recent local study in Singapore showed a vitamin D deficiency prevalence of 57.5% and vitamin D insufficiency of 34.5% in elderly patients admitted to hospital with hip fractures.⁽⁸⁾

Consequences of vitamin D deficiency

Vitamin D deficiency results in abnormalities in calcium, phosphorus and bone metabolism. Specifically, it causes a decrease in the efficiency of intestinal calcium and the phosphorus absorption of dietary calcium and phosphorus, resulting in an increase in parathyroid levels.^(9,10) In secondary hyperparathyroidism, serum calcium is maintained at the normal range at the expense of mobilising calcium from the skeleton and increasing phosphorus wasting in the kidneys. This process causes a generalised decrease in bone mineral density, resulting in osteopenia and osteoporosis. The secondary hyperparathyroidism also causes phosphaturia, which results in a low or low-normal serum phosphorus level. This leads to inadequate calcium-phosphorus levels and a mineralisation defect in the skeleton. In young children with little mineral in their skeleton, this defect results in rickets. In adults, the result is osteomalacia. Quantified by bone mineral density scores, osteomalacia presents symptomatically with isolated or generalised aches and pains in bones and muscles.⁽¹¹⁾ In the elderly, vitamin D deficiency causes increasing sway and frequent falls,^(12,13) increasing the risk of fracture. In addition to improvements in bone density and the prevention of falls and fracture, vitamin D may have several other putative benefits, including beneficial effects on the immune and cardiovascular systems.⁽¹⁴⁾

Table I. Common risk factors for vitamin D deficiency.

- Old age⁽¹⁵⁾
- Darker skin pigmentation⁽¹⁶⁾
- Works indoors
- Habitually wears long-sleeved or protective clothing, or stays in the shade⁽¹⁷⁾
- Exclusively-breastfed infants⁽¹⁸⁾
- Low calcium intake (e.g. lactose intolerance, dietary restrictions, vegans, etc)
- Obesity⁽¹⁹⁾
- Immobility and reduced kidney function in older people⁽²⁰⁾
- Chronic kidney disease^(21,22)
- Malabsorption syndromes or other conditions, e.g. Crohn's disease, cystic fibrosis, severe liver disease⁽²³⁾
- Taking drugs that have interactions, e.g. anticonvulsants, rifampicin, cimetidine, thiazides, corticosteroids^(24,25)
- Taking drugs that decrease absorption, e.g. mineral oil, laxatives, orlistat, cholestyramine⁽²⁶⁾

Some risk factors

Table I shows some common risk factors for vitamin D deficiency in the general population. For the elderly in Singapore, being housebound and of Malay ethnicity is significantly associated with vitamin D deficiency. In a recent study, 90.5% of the Malay patients had a vitamin D level of less than 20 µg/mL compared to 55.0% of the Chinese patients.⁽⁸⁾ Those at risk of vitamin D deficiency may be able to overcome it by increasing their exposure to sunlight or dietary intake of vitamin D. In children and adults, exposing the hands, face and arms to the sun for 10–15 minutes per day is usually sufficient. However, the amount of vitamin D that is produced from sunlight depends on the time of day, geographic location and the colour of one's skin. Vitamin D can also be obtained from food and dietary supplements. However, sources in food are limited and include oily fish such as salmon, sardines and mackerel, fortified foods such as margarine, dairy products and cereals, as well as eggs and liver. As vitamin D production in skin and from dietary intake varies among individuals, some patients require vitamin D supplementation.

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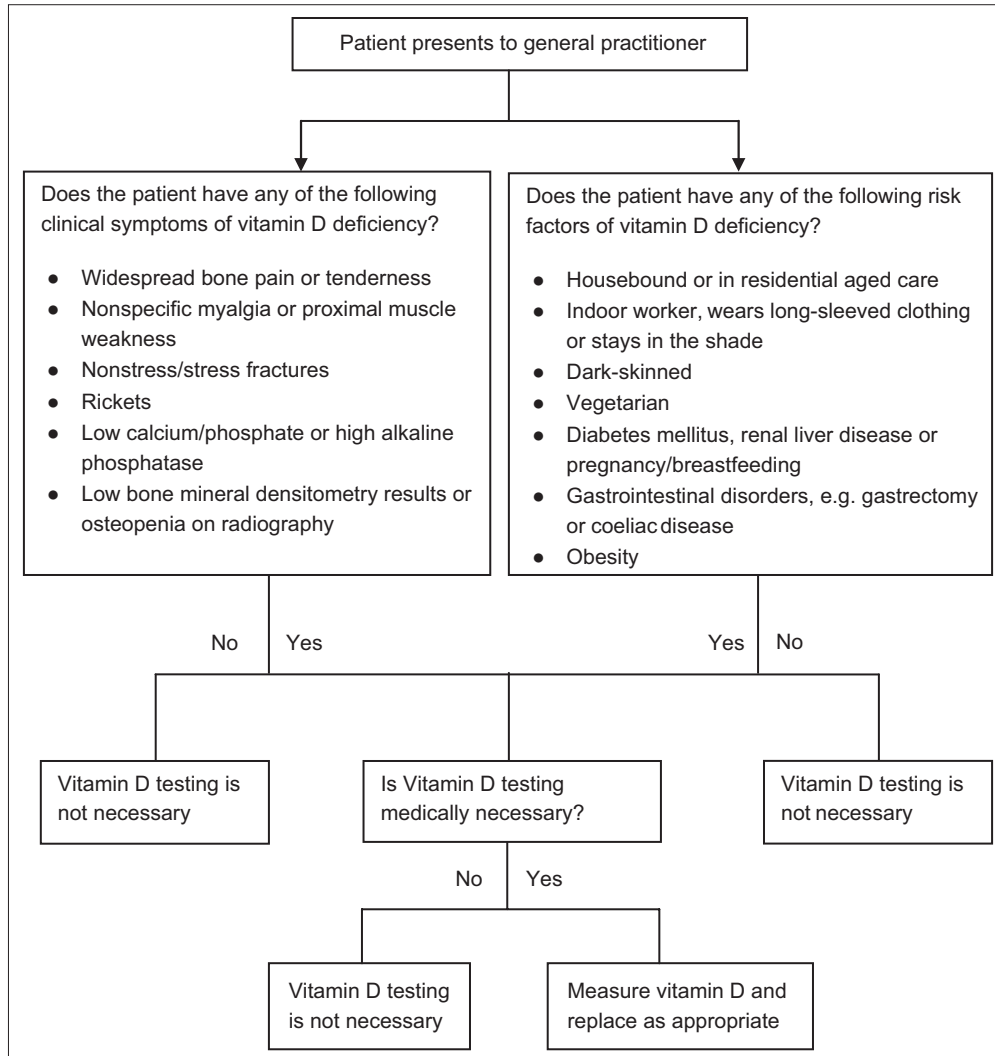


Fig. 1 Flow chart shows the decision-making process for vitamin D screening.

WHAT CAN I DO IN MY PRACTICE?

- Screen for vitamin D deficiency in high-risk populations. In this vignette, the population consists of elderly patients with a history of fragility fractures. Fig.1 shows the decision-making process for vitamin D screening, as adapted from Australian clinical practice guidelines.⁽²⁷⁾
- Ensure that patients on antiosteoporosis treatment have adequate vitamin D replacement. Vitamin D replacement regimes may differ according to the severity of the patient’s deficiency and tolerability of the medication.
- Retesting of vitamin D levels is advisable three months after commencing of supplementation.

Classifying and treating vitamin D deficiency

Classifying the severity of a patient’s vitamin D deficiency helps the physician to customise an appropriate replacement regimen (Table II).

Who should be treated with vitamin D supplementation

Vitamin D supplementation is recommended in people who have a confirmed vitamin D deficiency [25(OH)D < 30 µg/L].

Table II. Severity of vitamin D deficiency.

Level of vitamin D deficiency	Serum 25-hydroxyvitamin D concentration (µg/L)
Mild	10–19*
Moderate	5–9
Severe ⁽³⁾	< 5

*≥ 20 µg/L for the general population and ≥ 30 µg/L for elderly persons at risk of falls or people diagnosed with osteoporosis.

Treatment targets and frequency of review

Serum 25(OH)D concentration should be maintained at ≥ 20 µg/L in the general population and ≥ 30 µg/L in elderly persons at risk of falls or people diagnosed with osteoporosis. When initiating treatment for vitamin D deficiency/insufficiency or changing the dose, serum 25(OH)D typically should not be measured again for at least three months; this allows it to reach a steady state. After reaching the desired vitamin D concentration, no further testing is needed unless risk factors change. More frequent monitoring is required for patients with intestinal malabsorption who require high-dose oral therapy.

Table III. Treatment for vitamin D deficiency or insufficiency.

Level of vitamin D deficiency (serum 25(OH)D [$\mu\text{g/L}$])	Regimen
Insufficiency (20–29)	• Cholecalciferol 25–50 μg (1,000–2,000 IU) daily*
Mild deficiency (10–19)	
Moderate-to-severe deficiency (< 9)	• Cholecalciferol 75–125 μg (3,000–5,000 IU) daily for at least 6–12 weeks*; or
Severe deficiency (< 5)	• Ergocalciferol 1,250 μg (50,000 IU) once a month for 3–6 months
	• Ergocalciferol 1,250 μg (50,000 IU) weekly for four weeks and then once a month for 3–6 months. If high-dose ergocalciferol is not available, the cholecalciferol regimen for 25(OH)D < 10 $\mu\text{g/L}$ can be used

*Initial dose depends on serum 25(OH)D concentration. 25(OH)D: 25-hydroxyvitamin D

Regimens

Oral vitamin D supplements are available in vitamin D3 (cholecalciferol) or vitamin D2 (ergocalciferol) forms. Cholecalciferol, rather than ergocalciferol, is suggested when it is available. All patients should maintain a daily calcium intake of 1,300 mg (particularly older people in institutions), since the combination of calcium and vitamin D prevents fractures. Table III lists the recommended treatment regimens. Physicians should wait at least three months before checking the patient's serum 25(OH)D concentration again and should change to the therapy for mild vitamin D deficiency when the level rises to 10–19 $\mu\text{g/L}$. Most patients need ongoing treatment at the lower dose of cholecalciferol (i.e. 1,000 IU) daily.

WHEN SHOULD I REFER TO A SPECIALIST?

Referral should be considered when high doses of vitamin D are required in patients with special medical circumstances, including:

- Patients with a history of gastrectomy, fat malabsorption or those who require high, ongoing doses of vitamin D replacement due to underlying medical conditions.
- Patients presenting with rare cases of rickets or osteomalacia, e.g. X-linked hypophosphataemic rickets, vitamin D-dependent rickets, tumour-induced osteomalacia and renal osteodystrophy. These patients may need complex therapeutic regimens that include calcitriol.

You started Madam Fatimah on cholecalciferol and did a repeat 25(OH)D test four months after her vitamin D replacement. You were happy to see her walking into your consultation room without any walking aids and encouraged her to continue regular brisk walking. You wrote a quick memo to update her attending orthopaedic surgeon at her next review.

TAKE HOME MESSAGES

1. Vitamin D deficiency is common and may contribute to osteopenia and osteoporosis and falls risk in the elderly.
2. It is important to screen for vitamin D deficiency in high-risk patients, especially after a minimal-trauma fracture.
3. Vitamin D deficiency should be treated according to the severity of the deficiency and the availability of vitamin D preparations in the community.
4. In high-risk adults, follow-up 25(OH)D measurements should be made 3–4 months after initiating maintenance therapy to confirm that the target level has been achieved.
5. All patients should maintain a calcium intake of at least 1,000 mg for women aged ≤ 50 years and men ≤ 70 years, and 1,300 mg for women > 50 years and men > 70 years.

ABSTRACT Vitamin D deficiency is common and may contribute to osteopenia, osteoporosis and falls risk in the elderly. Screening for vitamin D deficiency is important in high-risk patients, especially for patients who suffered minimal trauma fractures. Vitamin D deficiency should be treated according to the severity of the deficiency. In high-risk adults, follow-up serum 25-hydroxyvitamin D concentration should be measured 3–4 months after initiating maintenance therapy to confirm that the target level has been achieved. All patients should maintain a calcium intake of at least 1,000 mg for women aged ≤ 50 years and men ≤ 70 years, and 1,300 mg for women > 50 years and men > 70 years.

Keywords: elderly, osteoporosis, vitamin D

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SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

(Code SMJ 201508A)

	True	False
1. Vitamin D deficiency is uncommon among elderly patients in temperate countries as there is usually sufficient sun exposure during the four seasons.	<input type="checkbox"/>	<input type="checkbox"/>
2. The prevalence of vitamin D deficiency is high in elderly patients with fragility fractures.	<input type="checkbox"/>	<input type="checkbox"/>
3. A recent local study in sunny Singapore has shown that the prevalence of vitamin D deficiency is lower than 34.5%.	<input type="checkbox"/>	<input type="checkbox"/>
4. Vitamin D deficiency results in abnormalities in calcium, phosphorus and bone metabolism.	<input type="checkbox"/>	<input type="checkbox"/>
5. Vitamin D deficiency causes a decrease in the efficiency of intestinal calcium and the phosphorus absorption of dietary calcium and phosphorus.	<input type="checkbox"/>	<input type="checkbox"/>
6. Vitamin deficiency results in a decrease in parathyroid levels.	<input type="checkbox"/>	<input type="checkbox"/>
7. In secondary hypoparathyroidism, serum calcium is maintained at the normal range at the expense of mobilising calcium from the skeleton and increasing phosphorus wasting in the kidneys.	<input type="checkbox"/>	<input type="checkbox"/>
8. Secondary hyperparathyroidism causes a generalised decrease in bone mineral density.	<input type="checkbox"/>	<input type="checkbox"/>
9. The phosphaturia caused by secondary hyperparathyroidism results in a low or low-normal serum phosphorus level.	<input type="checkbox"/>	<input type="checkbox"/>
10. In young children with little mineral in their skeleton, the phosphaturia caused by secondary hyperparathyroidism results in rickets.	<input type="checkbox"/>	<input type="checkbox"/>
11. Adults with osteomalacia can present with symptoms of isolated or generalised aches and pains in their bones and muscles.	<input type="checkbox"/>	<input type="checkbox"/>
12. Vitamin D deficiency causes increasing sway and frequent falls in the elderly, thereby increasing their risk of fracture.	<input type="checkbox"/>	<input type="checkbox"/>
13. Screening for vitamin D deficiency should only be done by endocrinologists in tertiary centres managing patients with complex osteoporosis.	<input type="checkbox"/>	<input type="checkbox"/>
14. Adequate vitamin D replacement is important while a patient is on antiosteoporosis treatment.	<input type="checkbox"/>	<input type="checkbox"/>
15. Vitamin D replacement regimes need to be customised according to the severity of the patient's deficiency and tolerability of the medication.	<input type="checkbox"/>	<input type="checkbox"/>
16. Checking of serum vitamin D levels is recommended within two weeks of supplementation.	<input type="checkbox"/>	<input type="checkbox"/>
17. Vitamin D supplementation is recommended for a patient with a serum 25-hydroxyvitamin D [25(OH)D] concentration of 40 µg/L.	<input type="checkbox"/>	<input type="checkbox"/>
18. Mild vitamin D deficiency [serum 25(OH)D 10–19 µg/L] or vitamin D insufficiency (20–29 µg/L) can be treated with cholecalciferol 25–50 µcg (1,000–2,000 IU) daily.	<input type="checkbox"/>	<input type="checkbox"/>
19. Moderate-to-severe vitamin D deficiency (serum 25(OH)D < 9 µg/L) can be treated with cholecalciferol 50–75 µcg (2,000–3,000 IU) daily for approximately four weeks.	<input type="checkbox"/>	<input type="checkbox"/>
20. Patients who have persistently low serum vitamin D levels despite taking high-dose supplements for adequate durations should be referred to specialists and may need complex therapeutic regimens that include calcitriol.	<input type="checkbox"/>	<input type="checkbox"/>

Doctor's particulars:

Name in full : _____
MCR number : _____ Specialty: _____
Email address : _____

SUBMISSION INSTRUCTIONS:

(1) Log on at the SMJ website: <http://www.sma.org.sg/publications/smjcurrentissue.aspx> and select the appropriate set of questions. (2) Provide your name, email address and MCR number. (3) Select your answers and click "Submit".

RESULTS:

(1) Answers will be published in the SMJ October 2015 issue. (2) The MCR numbers of successful candidates will be posted online at the SMJ website by 2 October 2015. (3) Passing mark is 60%. No mark will be deducted for incorrect answers. (4) The SMJ editorial office will submit the list of successful candidates to the Singapore Medical Council. (5) One CME point is awarded for successful candidates.

Deadline for submission: (August 2015 SMJ 3B CME programme): 12 noon, 25 September 2015.