Vitamin D and bone density, fractures, and falls: the end of the story?

DEBBIE RIGBY
ADVANCED PRACTICE PHARMACIST

@Drugby56

LEARNING OBJECTIVES

- Describe normal serum 25(OH)D levels, and levels indicating deficiency
- Identify groups at risk of vitamin D deficiency
- Describe the management of low serum 25(OH)D levels in different patient groups
TWO CLINICAL QUESTIONS

Should we screen for vitamin D deficiency?

What vitamin D intake to recommend for individual patients?

ROUTINE SCREENING

Generally healthy and free of major risk factors for vitamin D deficiency

Skeletal disorder or significant risk factors for vitamin D deficiency that can affect vitamin D metabolism or institutionalisation
DO NOT PERFORM POPULATION-BASED SCREENING FOR VITAMIN D DEFICIENCY

The quality of the evidence for the health benefits of an adequate vitamin D status is highly variable. As the main source of vitamin D is UVB sunlight exposure, vitamin D status as assessed by the measurement of 25 hydroxyvitamin D (25OH-D) is correlated with time spent outdoors, exercise and other aspects of a healthy lifestyle including body weight. Vitamin D insufficiency is associated with low levels of exercise, obesity and/or reduced sun light exposure, such as occur more commonly in the elderly, the overweight, the frail and unwell or institutionalised and where there are occupational, racial or cultural reasons. In individuals at risk of vitamin D deficiency, measurement of 25OH-D is an appropriate, case-finding strategy. Routine screening of healthy infants, children and adults (including pregnant women) for vitamin D deficiency is currently not recommended.

GROUPS AT RISK OF VITAMIN D DEFICIENCY

- Those with previous skin cancer or at high risk of skin cancer
- People who wear covering/concealing clothing
- Naturally very dark-skinned people
- People who spend long hours indoors, including housebound or institutionalised Australians
- Older adults
- Obese people
- Infants of vitamin D deficient mothers
Colecalciferol in supplements is derived from animal sources, through ultraviolet irradiation of 7-dehydrocholesterol from lanolin obtained from sheep.
CASE STUDY ONE
AN ACTIVE 38 YEAR OLD WOMAN

• Medical history of hypothyroidism – Rx thyroxine 50mcg/day
• No smoking, drinks one glass wine per day, outdoor exercise twice a week
• Diet well balanced – main source of calcium is milk on breakfast cereal
• Physical examination – mild osteoarthritis

• What further information do you need, if any?
• What would you recommend?

VITAMIN D DEFICIENCY AND THYROID DISEASE

• Some evidence on role of vitamin D as an immune modulator, reducing the incidence of autoimmune diseases
• Serum 25(OH)D levels significantly lower in patients with hypothyroidism – causal or marker of chronic disease?
• Hypovitaminosis D with hypocalcaemia significantly associated with the degree and severity of the hypothyroidism

FURTHER INFORMATION

Vitamin D levels are likely to change throughout the year with concentrations being highest in late summer and lowest at the end of winter.

Osteoporosis Australia recommends most people should have a vitamin D level of at least 50 nmol/L at the end of winter, which means people may have levels 10 – 20 nmol/L higher during summer (60-70 nmol/L).

FURTHER INFORMATION

Table 1: Safe sun exposure for vitamin D

<table>
<thead>
<tr>
<th>In Victoria</th>
<th>Fair to olive skin (Fitzpatrick skin types I-III)</th>
<th>Naturally very dark skin (Fitzpatrick skin types IV-VI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From September to April—when average UV levels are 3 and above</td>
<td>A few minutes of sun exposure to the face, arms and hands (or equivalent area of skin) before 10am or after 3pm on most days of the week should provide enough vitamin D.</td>
<td>2-4 times the exposure level of fair to olive skin. More sun exposure and supplementation may be required.</td>
</tr>
<tr>
<td></td>
<td>Sun protection is needed during those months.</td>
<td>It is not really necessary for people with this skin type to wear sunscreen but they should still wear a hat.</td>
</tr>
<tr>
<td>From May to August—when average UV levels are below 3</td>
<td>Approximately 2-3 hours of sun exposure to the face, arms and hands (or equivalent area of skin) across the week should help maintain vitamin D levels.</td>
<td>3-6 times the exposure level of fair to olive skin. More sun exposure and supplementation may be required.</td>
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<tr>
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<td>Sun protection is not needed unless you are in alpine regions or near highly reflective surfaces such as snow and water.</td>
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- What time of day does she exercise?
- Does she have dark skin?
- Overweight or obese?
- Family history of osteoporosis?
**UV INDEX**

- Vitamin D production **NOT** inhibited by use of sunscreen
- Sunscreens with high UVA protection encourage vitamin D synthesis (UVB generates vitamin D)
- Sunscreen use for daily and recreational photoprotection does not compromise vitamin D synthesis, even when applied under optimal conditions

WHAT DO YOU RECOMMEND?

- Food cannot provide an adequate amount of vitamin D
- If sun exposure cannot practically and safely be increased, recommend vitamin D supplement
- Increase dietary calcium (4 serves/day) and/or add calcium supplement
- Increase high-impact exercise – note mild osteoarthritis

VITAMIN D SUPPLEMENTS

<table>
<thead>
<tr>
<th>POPULATION GROUP</th>
<th>VITAMIN D DOSE</th>
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<tbody>
<tr>
<td>For people who obtain some sun exposure but do not achieve the</td>
<td>Under 70 years: at least 600 IU per day</td>
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<tr>
<td>recommended level of exposure</td>
<td>Over 70 years: at least 800 IU per day</td>
</tr>
<tr>
<td>For sun avoiders or people at risk of vitamin D deficiency</td>
<td>1,000-2,000 IU per day</td>
</tr>
<tr>
<td></td>
<td>7,000-14,000 IU per week</td>
</tr>
<tr>
<td>For people with moderate to severe vitamin D deficiency (&lt;30nmol/L)</td>
<td>3,000-5,000 IU per day for 6 weeks, then maintenance dose of 1,000-2,000 IU per day</td>
</tr>
</tbody>
</table>

WOULD YOU RECOMMEND ANOTHER TEST?

- May take 3-5 months to replete vitamin D levels – monitor following treatment in same laboratory
- Body can rely on tissue stores of vitamin D for between 30 and 60 days, assuming vitamin D levels adequate
- No further testing once at target, unless risk factors change
CASE STUDY TWO
A 78 YEAR OLD WOMAN, PRESENTS WITH FALL IN ED – PELVIC FRACTURE

- Otherwise well and active, height 165cm, weight 58kg
- Medical history – depression, hypertension, chronic pain
- Mother had #NOF at age 85
- Smokes 10 cigarettes per day, drink 3 glasses of wine a day
- Main source of dietary calcium is ‘some’ cheese about 3 times a week

- What further information do you need, if any?
- What would you recommend?
RISK FACTORS FOR OSTEOPOROSIS

- History of minimal trauma fracture
- Height loss ≥3 cm and/or back pain suggestive of vertebral fracture
- Female
- Older than 70 years of age
- History of falls
- Parental history of hip fracture
- Premature menopause or hypogonadism
- Prolonged use of glucocorticoids (at least three months cumulative prednisone or equivalent ≥7.5 mg per day)
- Use of other medications that cause bone loss

- Conditions or diseases that lead to bone loss
- Low body weight
- Low muscle mass and strength
- Low physical activity or prolonged immobility
- Poor balance
- Smoking
- High alcohol intake
- Energy, protein or calcium undernutrition
- Vitamin D insufficiency

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VITAMIN D REDUCES RATE OF COPD EXACERBATIONS

- Meta-analysis of 4 RCTs, n=560
- Reduced the rate of moderate/severe COPD exacerbations in patients with baseline 25-hydroxyvitamin D levels <25 nmol/L


OSTEOPOROSIS AUSTRALIA GUIDELINES 2017

Adequate but safe exposure to sunlight as a source of vitamin D
Calcium and vitamin D supplements should not be used routinely in noninstitutionalised elderly people. The absolute benefit of calcium and vitamin D supplements in terms of fracture reduction is low. There is evidence of significant benefit in people at risk of deficiency, particularly institutionalised individuals. Calcium and vitamin D supplements should be offered to people taking osteoporosis treatments if their dietary calcium intake is less than 1300 mg per day.
US PREVENTIVE SERVICES TASK FORCE RECOMMENDATIONS

- Inadequate evidence to estimate the benefits of vitamin D, calcium, or combined supplementation to prevent fractures in community-dwelling men and premenopausal women
- Adequate evidence that daily supplementation with 400 IU or less of vitamin D and 1000 mg or less of calcium has no benefit for the primary prevention of fractures in community-dwelling, postmenopausal women
- Adequate evidence that supplementation with vitamin D and calcium increases the incidence of kidney stones
- Recommendations do not apply to persons with a history of osteoporotic fractures, increased risk for falls, or a diagnosis of osteoporosis or vitamin D deficiency

WHAT DO YOU RECOMMEND?

Vitamin D supplement
- 3000-5000IU/day until levels 50-60nmol/L
- Check after 6 months, then drop to 1000-2000IU if above 50-60nmol/L

Adequate calcium and protein intake

Prevent falls and ensure exercise

Smoking cessation and reduce alcohol intake

Osteoporosis medication

Bisphosphonate, denosumab
CASE STUDY THREE

89 year old man in residential aged care – ambulance to ed after fall and unable to stand due to pain and external rotation of left leg

- Previous medical history: severe osteoarthritis, TKR (R), moderate dementia (MMSE 19/30), hypertension, type 2 diabetes, heart failure, mild CKD
- 4 falls in last 6 months – uses walker
- Medications: paracetamol, perindopril, metformin, HCT, vitamin D 50,000IU/month for 3 months

- What further information do you need, if any?
- What would you recommend?
WHAT FURTHER INFORMATION DO YOU NEED?

PTH 6.9pmol/L, creatinine 112µmol/L, eGFR 39mL/min, corr calcium 2.30mmol/L, albumin 28g/L

WHAT DO YOU RECOMMEND?

- Multiple comorbidities
- Many falls risk factors, likely #NOF
- Mobilisation, exercise within limits
- Dietary changes: calcium, protein
- Increase vitamin D to 50,000IU per week for at least 2 months
- Osteoporosis medication (bisphosphonate, denosumab)
- Do nothing? (surprise question)
Calcium and vitamin D supplements should not be used routinely in noninstitutionalised elderly people. The absolute benefit of calcium and vitamin D supplements in terms of fracture reduction is low. There is evidence of significant benefit in people at risk of deficiency, particularly institutionalised individuals. Calcium and vitamin D supplements should be offered to people taking osteoporosis treatments if their dietary calcium intake is less than 1300 mg per day.

Adequate but safe exposure to sunlight as a source of vitamin D is recommended for elderly people in care facilities to reduce the rate of falls. Calcium and vitamin D supplementation is recommended for the prevention of fracture in the frail elderly and institutionalised elderly.

THE ROLE OF VITAMIN D

- Strong evidence that vitamin D is beneficial for bone development and maintaining musculoskeletal health.
- For outcomes beyond bone health, including cancer, cardiovascular disease, asthma, diabetes, and autoimmune disorders, the evidence is inconsistent and inconclusive as to cause-effect relationship – association only.
VITAMIN D AND OMEGA-3 DO NOT PREVENT CANCER OR CARDIOVASCULAR DISEASE (VITAL STUDY)

- Vitamin D and omega-3 supplements are NOT effective in preventing cancer or major cardiovascular events in healthy adults
  - men and women aged ≥50 and ≥55 years, respectively
- Largest ever randomised trial of these supplements, n=25,871
  - vitamin D (colecalciferol 2000IU) and/or
  - omega-3 (EPA/DHA 1g)

NO DIFFERENCE IN INCIDENCE OF CANCER OR CARDIOVASCULAR EVENTS COMPARED WITH PLACEBO