

Maintaining bone health to prevent osteoporotic fractures

Osteoporotic fractures are a major public health problem — they occur in 1 in 2 women and 1 in 3 men over 60 years of age, and the incidence is rising.^{1,2} Fragility fractures can lead to premature death, pain, height loss and spinal deformity.¹ This *NPS News* outlines interventions for preventing osteoporosis and reducing fracture risk in those who develop the disease.

Lifestyle changes early in life can impact on bone health later in life

Lifestyle factors (see insert) contribute to bone mass and structure.³ Maximising bone mass during childhood and adolescence may decrease the risk of osteoporotic fractures in adulthood.^{3,4}

Optimise calcium intake

Adequate calcium is crucial in adolescence, when bone mass accrual is greatest.²⁻⁴ Children and adolescents often have poor intake due to substitution of milk with soft drinks, water or fruit juice; the perception that dairy foods are high in fat; and inadequate amounts being provided by parents.³⁻⁶

Encourage families to consume calcium-rich foods.⁴ Three to four serves of dairy foods per day is sufficient (one serve = 250 mL milk, or 200 g yoghurt, or 40 g cheddar cheese); the calcium content of reduced-fat and whole-milk products is similar.⁴⁻⁶

Calcium-fortified, or calcium-containing, foods are suitable for those who avoid dairy products or are lactose intolerant.⁴⁻⁶ Most provide readily absorbed calcium but their content varies.^{3,5,6} Supplements are needed if dietary intake is inadequate, which is common in the elderly.⁵

Case study 49 — now available online
(see inside for details)



Get the right amount of sunlight

Vitamin D deficiency reduces calcium absorption and is common in people with limited sunlight exposure.⁷ Major risk factors include:

- being elderly, institutionalised, housebound or non-ambulatory
- having dark skin or clothing that covers most of the head and body (e.g. veiling)
- malabsorption disorders (e.g. coeliac disease)
- chronic hepatic disease
- drugs that induce hepatic enzymes (e.g. some antiepileptics).^{2,5,7,8}

Vitamin D₃ (cholecalciferol) is formed in the skin by sunlight.⁵ Exposing the face, hands and arms (15% of the body) to 5–15 minutes of sun 4–6 times per week can prevent deficiency.⁷ The duration varies with latitude, season, age and skin colour (see insert).^{5,8}

Deliberate, prolonged sun exposure is not advised and is less efficient at producing vitamin D.⁷⁻⁹ Sunscreens can reduce vitamin D synthesis by > 95% but can be omitted for short incidental sun exposure.^{5,7,8} Avoid unprotected exposure between 10 am and 2 pm (11 am and 3 pm during daylight saving), as skin damage is more likely.

Men and women with inadequate sun exposure need vitamin D supplements.⁵ Dietary sources alone are insufficient, as only small quantities of vitamin D are found in food.^{5,8}

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Start exercise early

Regular exercise in childhood and adolescence increases bone mass more effectively than in adulthood.¹⁰ Weight-bearing exercise (e.g. jogging) has a greater effect than non-weight-bearing, stretching or flexibility exercises (e.g. swimming, yoga).^{3,4}

In children, before or during early puberty, moderate- to high-impact weight-bearing exercise can increase bone mass by 5% over 6 months.¹¹ Regular aerobic, weight-bearing and resistance exercise reduces bone loss in healthy adults, including postmenopausal women and can increase bone mass in adults by 1% to 3% over 1–2 years.^{10,12,13}

Stopping the first fracture in people at high risk

Fragility fractures have a domino effect — the risk doubles (at least) after a fracture at any site, and then increases further as more fractures occur.^{14,15} Men and women with a vertebral fracture are at greatest risk, being at least four times more likely to have another vertebral fracture than those without.¹⁵

Consider all risk factors when assessing fracture risk. Low bone mineral density (BMD) is a major factor but should not guide treatment alone.¹⁶ Box 1 outlines independent risk factors and the most important indicators for BMD testing.

The higher the absolute risk of fracture the greater the absolute benefit from treatment. There is no single standardised risk calculator, but men and women with low BMD who have other major independent risk factors are at high risk.¹⁶

Box 1: Risk factors for osteoporotic fractures^{13,16–19}

Major risk factors

- Advanced age (> 65 years)^{*†}
- Low BMD
- Female gender
- Early menopause (< 45 years of age)[†]
- Amenorrhoea (> 6–12 months)[†]
- Primary hypogonadism[†]
- Previous fragility fracture^{*†}
- Family history of fragility fracture^{*†}
- Low body weight or slim build^{*†}
- Oral glucocorticoid therapy^{*†}
- Increased propensity for falls^{*}
- Cigarette smoking^{*}

Other significant risk factors

- Asian or Caucasian race
- Regular excessive alcohol intake^{*}
- Sedentary lifestyle
- Prolonged immobilisation
- Inadequate calcium intake
- Vitamin D deficiency
- High bone turnover^{*}
- Other secondary causes of osteoporosis^{*†§}

* At least partly independent of BMD.

† Important risk factors that indicate the need for BMD testing in men and women.

§ E.g. rheumatoid arthritis, malabsorption syndromes, primary hyperparathyroidism, clinical hyperthyroidism, chronic renal or hepatic disease, long-term anticonvulsant therapy.

Role of calcium and vitamin D

Calcium, or vitamin D, supplements alone are unlikely to reduce the risk of fracture in healthy people with adequate intakes, or in those with an existing fracture.^{7,8,20–23} However, calcium (450–1200 mg/day) with cholecalciferol (700–800 units/day) has been shown to reduce the risk of hip and other non-vertebral fractures in elderly institutionalised women.^{20,22,24} These women had inadequate calcium and/or vitamin D intake but had no previous fracture.^{20,22,24}

Check for vitamin D deficiency in men and women at high risk (page 1). If deficient, provide a vitamin D supplement (cholecalciferol) in conjunction with adequate calcium. Higher doses than the adequate daily intake (see insert) are needed to treat moderate to severe deficiency (3000–5000 units daily for 6–12 weeks, then 1000 units daily thereafter).^{7,8}

Vitamin D deficiency is common in the elderly in residential care, and most will need supplements.^{7,8} Part of the benefit of vitamin D in this population could relate to improved muscle function and a reduction in falls.^{7,8}

Exercise

The goal of exercise in osteoporosis is to prevent falls — these cause 90% of hip fractures and 50% of vertebral fractures.^{2,3} There is no evidence that vigorous weight-bearing exercise prevents fracture in osteoporosis.^{2,10,20,25} Encourage men and women to undertake low-impact muscle strengthening, balance and stability exercises, such as Tai Chi and hydrotherapy, 2–3 times per week.^{3,10,17} Avoid activities that may cause fracture: trunk flexion (e.g. sit-ups), twisting movements and high-impact or abrupt loading (e.g. weights).¹⁰

Bisphosphonates: use them before the first fracture if risk is high

There is evidence that alendronate and risedronate prevent fracture in postmenopausal women without a vertebral fracture, but who are at high risk.^{26–29} These drugs are listed on the PBS for men and women without fracture who are aged ≥ 70 years and have a BMD T-score ≤ -3.0 .

Only test BMD in those willing to accept treatment. BMD tests are now subsidised by Medicare for men and women aged 70 years or over.

In the Fracture Intervention Trial, alendronate-treated women without vertebral fractures (mean age 68 years) but with low BMD (T-scores ≤ -2.5) had a greater reduction in their absolute risk of:

- any clinical fracture* (13.1% with alendronate vs 19.6% with placebo, NNT[†] = 15 over 4 years)
- radiographic vertebral fractures[§] (2.9% vs 5.8%, NNT = 34 over 4 years).²⁸

Risedronate has also been shown to reduce the absolute risk of a first vertebral fracture in women with low BMD (T-score -3.3) compared with placebo (2.6% vs 9.4%, NNT = 15 over a mean of 2 years).²⁹

Use other interventions (e.g. fall prevention) in conjunction with alendronate or risedronate. These drugs did not prevent all types of fracture in women at high risk, and some risk factors are not modified by drug treatment.^{27,28,30}

For more information on primary prevention of fractures, refer to *NPS RADAR: Alendronate (Alendro Once Weekly, Fosamax Once Weekly, Fosamax Plus) for osteoporosis in people at high risk of fracture* (at www.npsradar.org.au/npsradar/content/alendronate.pdf).

* Clinical fractures are vertebral and non-vertebral fractures that are symptomatic and come to medical attention.

† NNT = number who need to be treated with a bisphosphonate instead of placebo to prevent one fracture.

§ Detected radiographically as a decrease of 20% (15% for risedronate) and at least 4 mm in any vertebral height.

Emerging issues with bisphosphonates

Preventing osteonecrosis of the jaw

Osteonecrosis of the jaw is difficult to treat and may not resolve.^{31–33} Post-marketing reports of osteonecrosis of the jaw are rare and incidents have occurred months to years after starting a bisphosphonate.^{31–33} Most of the reported cases were after dental extraction, but stopping treatment before this may not reduce the risk.^{31–34}

Most cases involved intravenous bisphosphonates, used in multiple myeloma or metastatic breast cancer, but reports are emerging with oral use for osteoporosis.³³ The Adverse Drug Reactions Advisory Committee (ADRAC) received 106 reports (to June 2006) including 19 for alendronate and 2 for risedronate.³¹ Report suspected cases to ADRAC by using the 'Blue Card' distributed with *Australian Prescriber* (or at www.tgasime.health.gov.au).

Provide patients with consumer medicine information (CMI) so they are aware of signs and symptoms that may occur with treatment. Refer them to a dental specialist if there is exposed bone, pain, numbness, loose teeth or impaired healing in the jaw (especially after dental surgery) infection or local trauma.^{32,34}

Optimal treatment duration is uncertain

Studies provide data on fractures for up to 10 years, but the long-term effects of bisphosphonates have not been established.^{35–38}

Limited evidence suggests that treatment can stop after 5 years. Longer treatment may be considered for people at highest risk of fracture (e.g. multiple vertebral fractures), but this is controversial.

Overall, the incidence of fractures did not differ significantly between 10 years and 5 years of alendronate treatment^{36,37}, although there were fewer clinical vertebral fractures in one trial (2.4% vs 5.3%).³⁶ The rate of bone loss was slower with longer treatment, but BMD remained at or above pre-treatment baseline after 5 years of treatment.^{36,37} Extending 5-year treatment with risedronate for 2 years provided similar improvements in BMD and vertebral fracture risk to those observed in the first 3–5 years of treatment.³⁸

Consider stopping bisphosphonates after 3–5 years if:

- there is a significant increase ($\geq 5\%$) in BMD or no further bone loss
- no fractures occur during treatment.^{13,35–38}

Adherence to treatment is poor

Poor adherence is usually due to side effects or dosing inconvenience (e.g. sitting upright and avoiding food for at least 30 minutes), but patients may not perceive the benefits from treatment.³⁹ Check adherence regularly and discuss with patients how their treatment is working, and for how long it is needed.³⁹

Raloxifene in secondary prevention: for whom and for what benefit?

Alendronate or risedronate are first line for secondary prevention of vertebral and non-vertebral fractures.¹³ Raloxifene is a selective oestrogen-receptor modulator and is another option for postmenopausal women who:

- cannot take, tolerate or correctly use bisphosphonates
- are at high risk of breast cancer.^{35,40}

In women with osteoporosis and vertebral fracture, raloxifene 60 mg daily reduces the risk of new vertebral fractures by about one-third compared with placebo (absolute risk 14.7% vs 21.2%, NNT = 16 over 3 years).⁴¹ Raloxifene has not been shown to reduce the risk of non-vertebral fractures.^{40,41} It thus may be unsuitable for elderly women at high risk of hip fracture.

Raloxifene's main benefit is that it may protect against breast cancer — compared with placebo, raloxifene after 8 years reduced the hazard of invasive oestrogen-receptor-positive breast cancer by 76% (incidence 0.8 vs 3.2 cases per 1000 woman-years).⁴²

While protection against vertebral fracture and breast cancer may influence treatment decisions in some women, consider the harms and benefits for individuals. The risk of venous thromboembolism, although rare, is increased threefold by raloxifene, and other side effects (e.g. hot flushes, leg cramps) are more common than with placebo.⁴⁰⁻⁴²

What else can health professionals do to reduce the fracture burden?

Smoking, excessive alcohol intake and low body weight increase the risk of osteoporotic fractures (Box 1). Advise people, including adolescents, about the harmful effects of these on bone, in addition to that of inadequate calcium, vitamin D and exercise. Assist with smoking cessation and offer nicotine replacement therapy if appropriate.

Men and women who are likely to need long-term glucocorticoid therapy should receive the lowest dose possible that manages their condition; monitor BMD yearly if glucocorticoids are used for ≥ 3 months.^{13,17}

The effect of anti-resorptive drugs on fracture has mostly been studied in conjunction with calcium and vitamin D. Ensure an adequate daily intake is maintained during any drug therapy.

Routinely check older men and women for:

- falls in the past year
- deteriorating eyesight
- use of sedatives
- problems with balance (e.g. postural hypotension)
- exposure to sunlight
- physical activity and nutrition
- use of multiple medicines that may affect adherence.^{2,25}

The elderly who have recurrent falls or problems with gait or balance may benefit from a multifactorial risk assessment.²⁵ This could involve an occupational therapist, Home Medicines Review (HMR) pharmacist and/or multidisciplinary falls clinic.

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References available online at:
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The information contained in this material is derived from a critical analysis of a wide range of authoritative evidence. Any treatment decisions based on this information should be made in the context of the clinical circumstances of each patient.



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What intervention and how much?	What sources?																											
<p>Calcium (recommended daily intakes)</p> <p>Children (5–9 years): 800–1000 mg</p> <p>Children and adolescents (9–18 years): 1000–1300 mg</p> <p>Adults (≤ 70 years): 1000 mg</p> <p>Adults (> 70 years): 1300 mg</p> <p>Postmenopausal women: 1000–1300 mg</p>	<p>Diet</p> <p>Dairy foods (3 to 4 serves per day)</p> <ul style="list-style-type: none"> E.g. one serve = 250 mL milk, or 200 g tub of yoghurt, or 40 g cheddar cheese. <p>Non-dairy foods</p> <ul style="list-style-type: none"> E.g. almonds, beans, dried figs, tofu, broccoli, bok choy, tinned salmon and sardines. <p>Calcium-fortified foods (check product labels)</p> <ul style="list-style-type: none"> E.g. fruit juices, cereals, breakfast bars, breads, soy products. <p>Supplements</p> <ul style="list-style-type: none"> Calcium carbonate: 1500 mg tablets (= 600 mg elemental calcium). Calcium citrate: 1.19 g tablets (= 250 mg elemental calcium). 																											
<p>Vitamin D (adequate daily intakes)</p> <p>Children and adolescents: 200 units (5 micrograms)</p> <p>Adults (≤ 50 years): 200 units (5 micrograms)</p> <p>Adults (51–70 years): 400 units (10 micrograms)</p> <p>Adults (> 70 years): 600 units (15 micrograms)</p> <p>Adults at high risk of deficiency: 800 units (20 micrograms)</p>	<p>Sunlight exposure</p> <p>Exposure of the face, hands and arms (unblocked by sunscreen or glass) for 5–15 minutes 4–6 times a week can prevent vitamin D deficiency. The elderly need most frequent exposure; men and women with dark skin need 3–6 times the exposure for moderately fair skin.</p> <p>Duration of sun exposure to produce 1000 units of cholecalciferol (vitamin D₃) in moderately fair skin varies with latitude and season. Durations specified are at 10 am or 2 pm (11 am or 3 pm daylight-saving time).</p> <table border="1" data-bbox="1429 689 2150 957"> <thead> <tr> <th>Region</th> <th>Summer</th> <th>Winter</th> </tr> </thead> <tbody> <tr> <td>Cairns</td> <td>6–7 minutes</td> <td>9–12 minutes</td> </tr> <tr> <td>Townsville</td> <td>5–7 minutes</td> <td>9–13 minutes</td> </tr> <tr> <td>Brisbane</td> <td>6–7 minutes</td> <td>15–19 minutes</td> </tr> <tr> <td>Perth</td> <td>5–6 minutes</td> <td>20–28 minutes</td> </tr> <tr> <td>Sydney</td> <td>6–8 minutes</td> <td>26–28 minutes</td> </tr> <tr> <td>Adelaide</td> <td>5–7 minutes</td> <td>25–38 minutes</td> </tr> <tr> <td>Melbourne</td> <td>6–8 minutes</td> <td>32–52 minutes</td> </tr> <tr> <td>Hobart</td> <td>7–9 minutes</td> <td>40–47 minutes</td> </tr> </tbody> </table> <p>Diet</p> <ul style="list-style-type: none"> Fatty fish (e.g. salmon), meat, eggs, liver, vitamin D–fortified foods (e.g. margarine). <p>Supplements</p> <ul style="list-style-type: none"> Cholecalciferol (vitamin D₃): 25 microgram (1000 unit) tablets or capsules. Ergocalciferol (vitamin D₂): available in vitamin and mineral preparations; these generally do not contain sufficient quantities of vitamin D₂ to prevent or treat deficiency. 	Region	Summer	Winter	Cairns	6–7 minutes	9–12 minutes	Townsville	5–7 minutes	9–13 minutes	Brisbane	6–7 minutes	15–19 minutes	Perth	5–6 minutes	20–28 minutes	Sydney	6–8 minutes	26–28 minutes	Adelaide	5–7 minutes	25–38 minutes	Melbourne	6–8 minutes	32–52 minutes	Hobart	7–9 minutes	40–47 minutes
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<p>Exercise</p> <p>Children (> 8 years) and adolescents[†]: 10–45 minutes on most days of the week (if possible ≥ 60 minutes daily), including weight-bearing activities and short periods (e.g. 10 minutes) of high-impact activity involving jumping.</p> <p>Adults[‡]: ≥ 30 minutes most days, including weight-bearing exercise, strength or resistance training 2–3 times a week and if possible short periods (e.g. 10 minutes) of high-impact activity involving jumping.</p>	<p>Weight-bearing exercise</p> <p><i>High impact:</i> jumping, skipping, running, jogging, gymnastics, dancing, climbing stairs, hiking, skating, skiing, cycling, racquet sports (e.g. tennis), team sports (e.g. football, basketball, hockey, volleyball).</p> <p><i>Low impact:</i> walking, treadmill walking, ski machines, stair-step machines, rowing machines, water aerobics, low impact aerobics.</p> <p>Strength or resistance training</p> <p>Weight training, balance training (e.g. Tai Chi).</p>																											

* Examples provided are for Northern Australia (e.g. Cairns, Townsville), Central Australia (e.g. Brisbane, Perth) and Southern Australia (e.g. Sydney, Adelaide, Melbourne, Hobart).

‡ Men and women with osteoporosis should undertake exercise that improves muscle strength and balance, but avoid vigorous weight-bearing or other activities that may cause fracture (e.g. lifting weights).

† Optimal duration and frequency of exercise has not been established.

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