



Statement on Calcium and Vitamin D for Bone Health in Australian Adult Populations

Reviewed Aug 2021

Recommendations

Optimal fracture (broken bone) prevention by diet requires a combination of both calcium and vitamin D.

Healthy Bones Australia (formerly, Osteoporosis Australia) continues to support the National Health and Medical Research Council (NHMRC) Recommended Dietary Intake (RDI) of 1000 to 1300 mg of calcium per day in men and women. The RDI is the average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97–98 per cent) healthy individuals in a particular life stage and gender group and differs by age and gender (see Table 1). Ideally, this should be achieved by consuming a healthy dietary pattern rich in nutrient-dense calcium-rich foods, such as low-fat milk, yoghurt and fortified soy alternatives. When the calcium RDI cannot be achieved through dietary intake alone, calcium supplements are indicated. In these circumstances, Healthy Bones Australia recommends a daily supplement of 500-600mg of calcium at any time of the day. Many of the supplements available also contain vitamin D.

In the general population, ideal blood levels of vitamin D (25OH D) for older Australians are above 50 nmol/L at the end of winter/early spring. There is some evidence that blood levels over 160 nmol/L may increase fracture risk. In people with a blood level of 25OH D below 50 nmol/L, a daily supplement of 800 to 1000 IU of vitamin D per day may be needed to achieve serum 25OH D levels above 50 nmol/L. Large intermittent dose supplements by injection should be avoided because of possible toxicity.

These evidence-based recommendations for calcium and vitamin D to reduce falling and fractures apply to older men and women at high risk of falling and fracturing and do not necessarily apply to younger people with adequate levels of vitamin D and calcium. Individuals at increased risk of falls and fracture should seek advice from a health professional.

Adults at lower risk of fractures and falls should meet the RDI for calcium and achieve adequate vitamin D status.

Background

There has been concern about the large number of Australians not meeting guidelines for calcium intake or vitamin D status. There has also been uncertainty about the health benefit of testing for vitamin D deficiency using blood tests for 25OH D. As a consequence, there has been much discussion about the correct amount of calcium and vitamin D to reduce skeletal deterioration as we age. Some investigators have also raised concerns about adverse events in people taking calcium supplements. In 2017, the Scientific Committee of Osteoporosis Australia (now, Healthy Bones Australia) was asked to update a statement for all Australians on optimal calcium and vitamin D nutrition as part of a healthy lifestyle approach to reducing falls and fractures.

Calcium

Adequate calcium intake helps maintain the optimal level of serum (blood) ionized calcium without the need to make up the deficit from bone calcium. Bone calcium is important for bone strength by integration into crystals in the protein matrix - thus increasing bone resistance to bending. The NHMRC recommended daily calcium intake of 1000mg for men aged 50 to 70 years and 1300mg for men over 70 years and women aged



over 50 (Table 1)^{1,2}. However the last National Nutrition Survey reported that the mean daily food and beverage calcium intake in adults aged over 50 years is about 800 mg/day and that only 10% of older women and 10-30% of older men, are achieving the optimal intake from dietary sources alone³. In the survey, calcium supplements were consumed by 28% of older women and 15% of older men. In women, the median daily dietary calcium intake was 692mg. In women taking calcium supplements, the median daily intake rose to 1270mg. For men not taking calcium supplements, the median daily intake was 620mg, rising to over 1000mg in those taking calcium supplements⁴. The data demonstrated that even with supplements, about 60% of older women and 30% of older men were not achieving recommended calcium intakes. Unfortunately, there are no tests that reliably diagnose a low calcium diet. For example, a normal blood calcium level does not mean the dietary calcium intake is also normal. Healthy Bones Australia provides information on the calcium content of various foods on their website that allows you to calculate your calcium intake at <https://healthybonesaustralia.org.au/your-bone-health/calcium/>

Vitamin D

Vitamin D deficiency has an important role in bone health because this vitamin increases intestinal calcium transport and improves bone remodelling. In addition to effects on bone metabolism, there is now good data on the beneficial role of vitamin D on muscle function⁵. Vitamin D is produced by sunlight exposure on skin or from a limited range of foods containing vitamin D. Rich sources of vitamin D include fatty fish such as sardines, salmon and herring and fortified foods (for example, margarine and some milks). Ideal vitamin D status is best defined by a serum 25OH D level of >50 nmol/L at the end of winter/early spring, when levels are generally at their lowest⁶. Vitamin D deficiency or insufficiency, a serum 25OH D lower than 50 nmol/L, is found in more than one in five Australian adults - especially in older women and men in winter and spring⁷. Although testing for blood 25OH D is the recommended method for determining vitamin D deficiency, the inappropriate use of 25OH D screening (excessive testing in younger individuals with no clinical evidence of, or risk factors for, vitamin D deficiency) has resulted in a 2014 Government expert report advising restricting testing to patients with evidence of bone and mineral disorders and conditions predisposing to these disorders - a position supported by Healthy Bones Australia⁸.

Basis of recommendations

The recommendations outlined at the beginning of this statement are based on an extensive review of clinical trials of calcium and vitamin D supplementation in older people demonstrating a reduction in fracture risk of about 15%^{9,10}. In a major study that selected women with vitamin D insufficiency and low calcium intake, the fracture risk reduction was 32% with supplementation¹¹. Clinical trials where participants had a low calcium intake and vitamin D insufficiency demonstrate a more consistent fracture risk reduction with supplementation¹². For example, a meta-analysis that undertook a sub-analysis of 4 studies recruiting participants with low 25OH D reported a 30% reduction in falls associated with vitamin D supplementation¹³. In regard to patients receiving pharmaceutical agents to reduce fracture risk, for example bisphosphonates or denosumab, it is important to note that in all randomised controlled trials, participants were required to consume calcium and vitamin D to achieve similar intakes to those recommended here, prior to entering and during the study. Thus, to achieve optimal benefit, patients should follow the guidelines outlined in this document when taking the anti-osteoporosis drug prescribed by their doctor^{14,15}.



Concerns about potential adverse effects of these recommendations

Because large numbers of individuals are at risk of dietary deficiency, the safety of any recommendations that include advice on the use of supplements needs careful consideration.

Calcium

Calcium supplements can sometimes cause intestinal upset, especially constipation and abdominal pain¹⁶. A small increase in kidney stones has been demonstrated in some American studies¹⁷. One issue that has resulted in much controversy is whether calcium supplements increase the risk of heart disease and stroke. Despite extensive consideration, international scientific bodies have not supported these concerns when the dosage recommendations of 500 to 600mg per day are followed^{18,19}.

Vitamin D

Some studies of the effect of vitamin D on falling have utilised data in which high doses of vitamin were used, often in women with relatively normal 25OH D levels. Careful consideration of these studies and dose - ranging studies indicated that high monthly or yearly vitamin D doses, for example via injections may increase falls risk - especially in elderly women^{20,21,22}. An epidemiological study has also reported an increased risk of fracturing in the 20% of men with the highest blood 25OH D level²³. Hence, in people with a blood level of 25OH D below 50 nmol/L, a daily supplement of 800 to 1000 IU of vitamin D per day should be consumed. This is available in capsule or liquid form.

Conclusions

A recent National Health Survey indicated that large numbers of older women and men are not achieving recommended calcium intakes; in addition many have vitamin D insufficiency. Evidence from randomised clinical trials is that these Australians will benefit from increased consumption of both calcium and vitamin D, especially if they are at risk of falls and fractures. The importance of these recommendations for public health should be addressed as a matter of urgency.

References

1. NHMRC. Australian Dietary Guidelines. 2012 http://consultations.nhmrc.gov.au/open_public_consultations/dietary-guidelines.
2. National Health and Medical Research Council (Australia), New Zealand. Ministry of Health, Australia. Dept. of Health and Ageing. Nutrient reference values for Australia and New Zealand : including recommended dietary intakes. [Canberra, A.C.T.: National Health and Medical Research Council]; 2006.
3. Australian Bureau of Statistics. 4364.0.55.008 - Australian Health Survey: Usual Nutrient Intakes, 2011- 12 2015.
4. Australian Bureau of Statistics. 4364.0.55.010 - Australian Health Survey: Nutrition - Supplements, 2011-12 2015.
5. Girgis CM, Clifton-Bligh RJ, Hamrick MW, Holick MF, Gunton JE. The roles of vitamin d in skeletal muscle: form, function, and metabolism. *Endocr Rev.* 2013;34(1):33-83.
6. Nowson CA, McGrath JJ, Ebeling PR, et al. Vitamin D and health in adults in Australia and New Zealand: a position statement. *Med J Aust.* 2012;196(11):686-687.
7. Gill TK, Hill CL, Shanahan EM, et al. Vitamin D levels in an Australian population. *BMC Public Health.* 2014;14:1001.
8. Australian Government Dept. of Health, MBS Reviews, Vitamin D Testing Report. 2014; [http://www.health.gov.au/internet/main/publishing.nsf/content/02E10F68DB67D494CA257EB9001E518E/\\$File/Vitamin%20D%20testing%20Review%20Report.pdf](http://www.health.gov.au/internet/main/publishing.nsf/content/02E10F68DB67D494CA257EB9001E518E/$File/Vitamin%20D%20testing%20Review%20Report.pdf).



9. Bolland MJ, Grey A, Gamble GD, Reid IR. The effect of vitamin D supplementation on skeletal, vascular, or cancer outcomes: a trial sequential meta-analysis. *The Lancet Diabetes & Endocrinology*. 2014;2(4):307-320.
10. Avenell A, Mak JC, O'Connell D. Vitamin D and vitamin D analogues for preventing fractures in postmenopausal women and older men. *Cochrane Database Syst Rev*. 2014;4:CD000227.
11. Chapuy MC, Arlot MF, Duboeuf F, et al. Vitamin D3 and calcium to prevent hip fractures in elderly women. *N Engl J Med*. 1992;327:1637-1642.
12. Bischoff-Ferrari HA, Willett WC, Orav EJ, et al. A pooled analysis of vitamin D dose requirements for fracture prevention. *N Engl J Med*. 2012;367(1):40-49.
13. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev*. 2012(9):CD007146.
14. Cummings SR, San Martin J, McClung MR, et al. Denosumab for prevention of fractures in postmenopausal women with osteoporosis. *N Engl J Med*. 2009;361(8):756-765.
15. Black DM, Reid IR, Boonen S, et al. The effect of 3 versus 6 years of zoledronic acid treatment of osteoporosis: a randomized extension to the HORIZON-Pivotal Fracture Trial (PFT). *J Bone Miner Res*. 2012;27(2):243-254
16. Lewis JR, Zhu K, Prince RL. Adverse events from calcium supplementation: relationship to errors in myocardial infarction self-reporting in randomized controlled trials of calcium supplementation. *J Bone Miner Res*. 2012;27(3):719-722.
17. Jackson RD, LaCroix AZ, Gass M, et al. Calcium plus vitamin D supplementation and the risk of fractures. *N Engl J Med*. 2006;354(7):669-683.
18. Harvey NC, Biver E, Kaufman JM, et al. The role of calcium supplementation in healthy musculoskeletal ageing : An expert consensus meeting of the European Society for Clinical and Economic Aspects of Osteoporosis, Osteoarthritis and Musculoskeletal Diseases (ESCEO) and the International Foundation for Osteoporosis (IOF). *Osteoporos Int*. 2017;28(2):447-462.
19. Chung M, Tang AM, Fu Z, Wang DD, Newberry SJ. Calcium Intake and Cardiovascular Disease Risk: An Updated Systematic Review and Meta-analysis. *Ann Intern Med*. 2016;165(12):856-866.
20. Sanders KM, Seibel MJ. Therapy: New findings on vitamin D3 supplementation and falls - when more is perhaps not better. *Nat Rev Endocrinol*. 2016;12(4):190-191.
21. Smith LM, Gallagher JC, Suiter C. Medium doses of daily vitamin D decrease falls and higher doses of daily vitamin D3 increase falls: A randomized clinical trial. *J Steroid Biochem Mol Biol*. 2017;173:317- 322.
22. Sanders KM, Stuart AL, Williamson EJ, et al. Annual high-dose oral vitamin D and falls and fractures in older women: a randomized controlled trial. *JAMA*. 2010;303(18):1815-1822.
23. Bleicher K, Cumming RG, Naganathan V, et al. U-shaped association between serum 25-hydroxyvitamin D and fracture risk in older men: results from the prospective population-based CHAMP study. *J Bone Miner Res*. 2014;29(9):2024-2031.

Table 1:

Age (yrs)	Men	Women
19-30	1,000 mg/day	1,000 mg/day
31-50	1,000 mg/day	1,000 mg/day
51-70	1,000 mg/day	1,300 mg/day
>70	1,300 mg/day	1,300 mg/day

Table 1 Recommended Dietary Intake for calcium by age and gender for Australians. The RDI is the average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all healthy individuals.