

Vitamin d supplements for elderly bone health



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'Do older people in residential care need to consume a dietary supplement to maintain health?': The case for Vitamin D supplementation in relation to Bone Health. .

Introduction

Vitamin D and Bone Health overview

Bone health is a critical factor for healthy ageing. Bones are responsible for many of the body's functions, including movement, organ protection, blood cell production, mineral storage, and support for the rest of our body. Genes and the environment contribute to an individual's bone health as well as environmental factors, such as diet and physical activity play a critical role in the health of bones throughout the lifespan, and importantly these factors can be modified. Nutritional deficiencies, such as insufficient Vitamin D intake, can result in weak, poorly mineralised bones, and hence bone mass and strength. The most common bone disease is osteoporosis, which typically doesn't occur until late in life. Bone loss results as bones continue to breakdown, but bone formation, or remodelling, is reduced. The resultant loss of bone mass leads to structural abnormalities that make the skeleton more fragile. This resultant fragility increases the risk of fractures with or without trauma. ^{1, 2}

Vitamin D is crucial in maintaining bone health as it promotes calcium absorption in the gut and maintains calcium and phosphate levels in the blood, enabling normal mineralisation of bone. Vitamin D is also required for bone growth and bone remodelling, hence it is critical for bone health.

Vitamin D is a group of fat-soluble compounds which exist in two major

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forms: Vitamin D2, formed from the plant sterol ergosterol and synthesized by ultraviolet irradiation, that is, exposure to sunlight and Vitamin D3 which is synthesized in the human body, when naturally occurring 7-dehydroxycholesterol is molecularly changed due to sun exposure. Vitamin D3 is also found in animal-based food such as fatty fish, liver, milk, eggs. Both Vitamin D2 and D3 are metabolised to 25-hydroxyvitamin D [25(OH)D] in the liver and serum 25(OH)D is used to assess an individual's Vitamin D levels. ^{1, 3, 4, 5, 6, 7, 8}

Measurement of Vitamin D and Bone Health

Table 1: Serum 25(OH)D concentrations and target status

Vitamin D status	Vitamin D [25(OH)D serum levels (nmol/L)
Optimal	> 75
Sufficient	50-75
Mild deficiency	30-49
Moderate deficiency	12.5-29
Severe deficiency	< 12.5

* 5, 9, 10

It is commonly identified that there are marked inconsistencies in recommended concentrations of serum 25(OH)D levels in relation to requirements for achievement of good bone health and other health outcomes. The above table outlines general accepted guidelines. Vitamin D deficiency has also been defined as a serum 25(OH)D level ranging from less than 50nmol/L through to 90nmol/L. Other studies define Vitamin D sufficiency as 75nmol/L serum 25(OH)D and above, based on observational studies of Vitamin D and health outcomes in relation to bone mineral density (BMD), lower-extremity function, and the risk of falls and fractures, with the best outcomes achieved when serum 25(OH) levels are between 90-100nmol/L. It has been clearly identified that optimal levels required of Vitamin D, relating to a range of health outcomes, including bone health, remains controversial and current trial evidence supporting higher levels is very limited. Furthermore, optimal levels appear to be ≥ 50 or 60nmol/L, with the higher value recommended for summer months, allowing for seasonal declines. ^{2, 4, 5, 9, 10, 23}

A key indicator of bone health in ageing is incidence of osteoporosis. In 2012 it was estimated that 66% of Australians over the age 50 had poor bone health, including more than one million with osteoporosis. This incidence is expected to rise by over 30% by the year 2022. Incidence of fracture related to osteoporosis and osteopenia is expected to rise at similar rates if diagnosis and management of these conditions does not improve. A key factor is utilising guidelines for assessment and management of osteoporosis, which may include bone density assessment as a marker of osteoporosis and osteopenia. ^{2, 11, 12}

Recommendations to achieve sufficient Vitamin D levels for bone health

Due to the increased risk of Vitamin D deficiency associated with elderly persons living in residential care a recommendation is made that serum 25(OH)D levels are monitored. The risk occurs for this group specifically, in contrast to the elderly population living in the community setting, due to reduced exposure to sunlight, resulting from living in an institutional setting. General requirements for the elderly population also occur as a result of reduced ability to metabolise and utilise available Vitamin D. The National Health and Medical Research Council (NHMRC) recommend the daily Adequate Intake of Vitamin D as 10-15 micrograms for those over 50 years, based on age, and minimal expected sun exposure. The general population receive only 10-15% of their Vitamin D from their diet. For those older persons living in residential care it would be expected that this requirement is higher, although this does not need to be the case. Experimental data indicates that exposure of approximately 15% of the body, that is, arms and hands or equivalent for 5-9 minutes in the summer months and up to 30 minutes in winter months is sufficient to maintain Vitamin D levels in a range that is sufficient for healthy bones. People with darker skin may require 3-6 times longer exposure to sun. Should residents in care be provided with both the opportunity and facilities to obtain sufficient sun exposure, whilst reducing risks associated with over-exposure to sun, coupled with sufficient dietary intake, optimum levels of Vitamin D can be achieved. ^{9, 13, 14, 15, 25}

Table 2 below outlines food sources of Vitamin D. Generally, food sources only make up 10-15% of total Vitamin D. Including small amounts of Vitamin D containing foods, such as fish, liver and eggs can assist in meeting this

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level of daily Vitamin D intake. Dietary intake, in combination with meeting required sun exposure targets, can support individuals in achieving sufficient serum 25(OH)D levels, thus not requiring supplementation, which has not shown clear benefit in relation to bone health outcomes across various populations. Studies showing comparisons between the effectiveness of sun exposure versus vitamin D supplementation are currently limited, although a large scale study is currently underway in Australia to assess the effectiveness of sun exposure and Vitamin D supplementation for the management of Vitamin D insufficiency.^{11, 13, 14, 16, 17}

Table 2: Food sources of Vitamin D and percentage of daily AI.

Food	Serving size	Units per serving	% of daily AI (15 micrograms)
Cod Liver Oil	1 tablespoon	34	227
Swordfish (cooked)	85 grams	14	93
Salmon	75 grams	8-11	53-73
Tuna, canned in water	85 grams	4	27
Snapper, cooked	75 grams	10	67

Margarine (fortified)	1 tablespoon	1.5	10
Sardines, canned in oil	2	1	7
Liver, beef, cooked	85 grams	1	7
Egg (Vit D in yolk)	1 large	1	7
Pork, cooked	75 grams	Up to 1.5	10
Mushrooms, white	100 grams	1.5	10

*16, 17

In addition to assessment of Vitamin D status, it is also recommended that residents are assessed for risk factors relating to bone health, which can also correlate with Vitamin D deficiency such as osteoporosis and fracture. ³¹

Justification of recommendations for achieving sufficient Vitamin D levels for bone health

There is mounting evidence that Vitamin D supplementation does not have clinically significant benefits for bone mineral density, or prevention of fractures and falls, regardless of serum 25(OH)D levels. As a result there is

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little justification in using Vitamin D supplements to maintain or improve bone health in the elderly population. A broad range of study designs and population groups have been studied, but there are consistently neutral results regarding bone mineral density, falls and fractures. It has been concluded that for frail older people living in institutions, Vitamin D supplementation alone is unlikely to prevent fracture. As this supplement can result in gastrointestinal symptoms and renal disease it can clearly be concluded that supplementation of Vitamin D in this population group in the hope of achieving better outcomes for bone health is certainly not warranted nor feasible. ^{18, 19, 20, 21}

Serum 25(OH)D levels remain a useful and relevant marker for Vitamin D levels in the general population, including the elderly. A blood test funded through Medicare for groups at high risk of Vitamin D deficiency and populations with known poor bone health will provide a useful guide and can be used to determine appropriate care for those living in residential care. Although discrepancies do occur, most consistently, data suggests aiming for a serum 25(OH)D level of 60nmol/L in the summer months, to accommodate for seasonal reductions, ensuring that levels are above 50nmol/L resulting in optimal mineral metabolism, bone density and bone health. ^{4, 14, 15, 22, 23}

The following NHMRC recommendations for Vitamin D intake assumes that an individual receives no, or minimal exposure to sunlight. Males and females in the 51 to 70 year old age bracket both require 10 micrograms per day, for those over 70 years, the daily Adequate Intake (AI) is 15 micrograms per day. The NHMRC recommendation for over 70 year olds is based on the

general population, and doesn't factor those who are institutionalised or bed bound, and are therefore likely to have very limited sun exposure, and potentially reduced dietary intake. For this group, they recommended supplementation of 10-25 micrograms of Vitamin D may be required. Several Australian and New Zealand studies have shown a high incidence of deficiency in very elderly people who have restricted sunlight access, many of whom are living in residential care facilities. Estimated deficiency rates range from 15-52% in Australia. A number of studies have also demonstrated protection from falls and fractures when Vitamin D supplementation is provided for the elderly, although more extensive meta-analysis contradicts these findings. ^{6, 24, 25}

It is well reported that dietary intake of Vitamin D accounts for only 10-15% of intake, with the remainder achieved from sun exposure. For those people with moderately fair skin, exposure of their arms, or an equivalent area, in the outdoors, for 6-7 minutes mid-morning or mid-afternoon on most days, in the Australian summer will maintain sufficient Vitamin D levels. Up to 30 minutes of outside sun exposure is required during the winter months, depending on the latitude one resides. In southern latitudes, sufficient UVB radiation will only be produced during the middle of the day. As Vitamin D supplementation has been shown to have little benefit for bone health outcomes, yet Vitamin D levels are crucial for healthy bones, it is clear that sun exposure is critical in maintaining healthy levels of Vitamin D, particularly for those persons living in residential care. Ensuring these residents also meet their required recommended dietary intake will also be important. ^{9, 10}

Summary

There is no doubt that adequate serum Vitamin D levels are essential for good bone health. Discrepancies exist regarding optimal levels, and how best to achieve positive outcomes in relation to bone health. Recent research does not support supplementation of Vitamin D when specifically related to maintenance of bone health. This recommendation also considers side-effects caused by Vitamin D supplements. Ensuring that dietary intake achieves the expected range of 10-15% of Vitamin D levels, coupled with adequate sun exposure to meet the remaining production of Vitamin D should ensure that Vitamin D levels contribute to healthy bones in elderly people living in residential care.

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