

This factsheet aims to increase awareness of the importance of calcium in the diet by supporting bone health during adolescence and old age. The following information will provide a better understanding of the role calcium plays in providing bone strength and structure as well as reducing the risk of osteoporosis. (1)

What is the role of calcium in normal functioning of the human body?

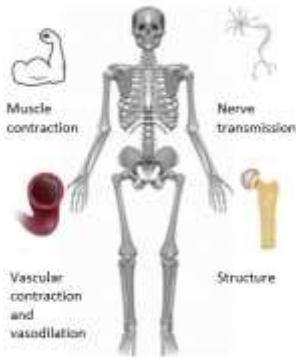


Figure 1: The role of calcium in the human body. (3,4)

Calcium is an essential nutrient that contributes to peak bone mass (90%) during late adolescence to early adulthood. (2) Whilst being the most abundant mineral in the body, calcium serves two important roles. This is related to bone structure by providing rigidity and strength as well as serving as a calcium bank which is available for body fluids if required. Calcium that is “present in the blood, extracellular fluid and muscles contributes to bodily functions such as vascular contraction and vasodilation, muscle contraction and nerve transmission” (Fig.1). (3, 4) Calcium’s main function is structural with approximately 99% stored in bones and teeth. (4) During adolescence, adequate calcium intake is required for bone development and to achieve optimum peak bone mass (PBM). (5) PBM decreases with advancing age and is most prevalent in those aged 50+ years.

“Osteopenia is a condition associated with lower than normal bone mineral density but not low enough to be considered, osteoporosis”.

Figure 2: Osteopenia (13)

This highlights the importance of calcium in maintaining musculoskeletal homeostasis and preventing bone mineral density losses during the older adult years. (6) It is estimated that 4.74 million Australians over 50 years of age have “osteoporosis, a condition characterised by low bone mass and deterioration of bone tissue”, osteopenia (Fig.2) or poor bone health and are at risk of bone fractures. This figure is expected to rise to 6.2 million Australians by 2022 at an estimated cost of \$3.84 billion to the government. (6, 7, 8)

What are the current dietary recommendations?

The Australian Dietary Guidelines (2013) suggests that there are considerable advantages for “including calcium-rich dairy foods and/or their alternatives as part of a healthy diet”. (7) These guidelines recommend the following minimum recommended number of serves:

- 2 ½ serves/day for boys and 3 serves/day for girls 9-11 years.
- 3 ½ serves/day for both boys and girls 12-13 and 14-18 years.
- 2 ½ serves/day for men and women 19-50 years.
- 2 ½ serves/day for men and 4 serves/day for women 51-70 years.
- 3 ½ serves/day for men and 4 serves/day for women 70+ years. (7)

Calcium requirements are dependent on a person’s age and gender. Habits established during early growth years are more likely to track into adulthood. (8) The recommendations for adequate dietary calcium intake are shown in Table 1. (9)

Table 1: Nutrient Reference Values-Calcium

Age Group	Calcium mg/day				
	Estimated Average Requirement (EAR)		Recommended Dietary Intake (RDI)		Adequate Intake (AI)
	Males	Females	Males	Females	Infants
0-6 months					210
7-12 months					270
Children & Adolescents					
1-3 years	360	360	500	500	
4-8 years	520	520	700	700	
9-11 years	800	800	1000	1000	
12-13 years	1050	1050	1300	1300	
14-18 years	1050	1050	1300	1300	
Adults					
19-30 years	840	840	1000	1000	
31-50 years	840	840	1000	1000	
51-70 years	840	1100	1000	1300	
>70 years	1100	1100	1300	1300	

Table 1. Source: National Health and Medical Research Council of Australia (2006, updated 2017) Nutrient Reference Values for Australia and New Zealand Including Recommended Dietary Intakes (9)

How much is too much?

To reduce the risk of toxic effects of calcium, the upper level of intake (UL) is conservatively set at 2,500 mg/day for all children, adolescents and adults (excluding infants). (9) Intakes above the upper level may result in an increased risk of cardiovascular disease, strokes and kidney stones. (10)

Consequences of inadequate calcium intake

An inadequate consumption of calcium is associated with decreased bone density and mass. This is a result of the body drawing on more calcium from the bones to supply calcium to the blood. (1, 3) Consequently, this leads to a dietary calcium deficiency, heightening the risk of developing osteoporosis later in life resulting in a reduced resistance to age-related bone loss and fractures. (3, 4, 9) Calcium intake during adolescence is fundamental as “45-50% of skeletal bone growth is completed within this period”. (4) Despite this, a pattern of declining intake has been reported in Australia with 89% of children aged 4-8 years satisfying the EAR for calcium compared with 38% of adolescents aged 14-16 years. (11) Inadequate intake is more prevalent in adolescent females with an estimated 90% currently not meeting the EAR for calcium compared to 71% of adolescent males aged 14-18 years. (12, 13) Bone loss starts post puberty and is a result of the resorption rate exceeding the formation rate. Menopausal women and advancing age are associated with a decline in calcium absorption and this is exacerbated by inadequate calcium intake. (3, 10, 13) The elderly is also an age group particularly susceptible to calcium deficiency and osteoporosis. As a result, calcium requirements increase among older adults particularly women over 50 and men over 70 years due to bone mineral loss. (1, 10) Osteoporosis is a risk factor for bone fragility and fracture. (1)

What does the current evidence say about calcium supplementation strategies?

To address the inadequate calcium intake of children and adolescents, the implementation of dietary pattern strategies are needed in the early years to ensure that the EAR, RDI and recommended daily servings are being met. To reduce the risk of osteoporosis related bone fractures occurring in later life, effective treatments can be used. Calcium supplements have been recommended as a preventative and treatment strategy for at risk individuals with calcium deficient diets. (6) Recent research has investigated the usefulness of calcium supplementation alone or in combination with vitamin D, important for calcium absorption and effective bone cell functioning. (14, 15) Studies relating specifically to adolescents and the elderly have reported that:

- Dairy food is consumed by most children and is an important contributor to calcium intake. Milk is the most consumed dairy food. The incorporation of milk and dairy products in the diets of adolescents is considered the best strategy for meeting the EAR for calcium. (4, 11)
- Calcium supplementation at doses more than 230mg/day for 2 years enhances total body bone mineral accretion in male adolescents with insufficient dietary calcium intake. (16)
- Calcium supplements alone will not prevent bone fractures. Trials involving a combination of calcium (1000-1200mg/day) and vitamin D supplementation have shown an increase in bone mineral density and a reduction in bone fractures. (6, 17, 18)
- Daily supplementation with calcium (1200mg/day) and vitamin D is associated with a 16% reduced risk of hip

fracture, the most serious osteoporotic fracture and a reduced risk of any fracture of 6% in older adults (mean age 68.6 years). (18)

- Supplementation of calcium (1000-1200mg/day) plus vitamin D could reduce the risk of total and hip fractures by 15 and 30% and is an effective intervention strategy for community-dwelling and institutionalised older aged individuals. (14, 15)
- Whilst dietary calcium is the preferred source of calcium, calcium supplements may be beneficial for reducing fracture risk in individuals with inadequate calcium intake. Supplements should be limited to 500-600mg/day. (19)

Table 2: Calcium content of selected foods

Food	Value per 100g	Food	Value per 100g
Cheese, parmesan, fresh	970mg	Yoghurt, natural, regular fat (3% fat)	182mg
Cheese, cheddar, processed, reduced fat	886mg	Yoghurt, vanilla flavoured, (2% fat)	177mg
Cheese, edam	810mg	Bread roll, mixed grain	160mg
Cheese, mozzarella	685mg	Bread roll, from white flour	112mg
Cheese, camembert	490mg	Crumpet, from white flour, toasted	92mg
Chocolate, milk	252mg	Salmon, red, canned in brine, drained	130mg
Milk, cow, fluid, reduced fat (1% fat)	120mg	Salmon, flavoured, canned, undrained	102mg
Milk, cow, fluid, skim (0.15% fat)	120mg	Nut, almond, with skin, raw, unsalted	265mg
Milk, cow, fluid, regular fat (3.5% fat)	107mg	Nut, walnut, raw, unsalted	89mg

Table 2. Source: Food Standards Australia New Zealand, Australian Food Composition Database (20)

Recommendations

A diet rich in calcium is the best way of achieving the current dietary guideline recommendations. Dairy foods are a rich source of readily absorbable dietary calcium. The evidence recommends that adolescents consume calcium-rich foods more frequently including milk, cheese and yoghurt and preferably reduced-fat varieties as shown in table 2. (11, 20) Whilst calcium is essential for bone health throughout all life stages, adequate dietary calcium intake is critical during childhood and adolescence when peak bone mass is achieved. (16) Based on scientific evidence, calcium supplementation may be recommended when dietary intake is insufficient or to accompany the treatment of osteoporosis. Supplementation alone will not prevent fractures and should therefore be considered as part of a treatment plan. (1)

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