AIS SPORTS SUPPLEMENT FRAMEWORK
CALCIUM SUPPLEMENT

What is it?

> Calcium is the most abundant mineral in our diets. About 1% of the calcium in our bodies is used to support metabolic functions, including muscle contraction. The other 99% is found in bones and teeth where it provides both a structural and functional role. Bone is a dynamic tissue that is constantly being broken down and rebuilt. The balance between bone resorption and rebuilding determines whether there is an increase in bone mass (childhood and adolescence), a relative stability in peak bone mass (adulthood) or bone loss (ageing, especially in post-menopausal women). Like muscle, bone needs time to rest and repair. When recovery time is restricted, such as in intense, prolonged and repeated training, bone resorption exceeds bone formation, microdamage accumulates and BMD decreases.[11]

> In addition to maintaining both short- and long-term bone health, calcium plays an integral role in nerve impulse conduction and muscle contraction, regulation of blood pressure and maintaining a regular heartbeat, blood clotting, maintaining water balance, secretion of hormones and normal brain function. For these functions to occur optimally, oral calcium intake must be maintained so that plasma calcium can be preserved and only complemented from body stores (i.e. bone) when essential.

> Calcium requirements during the life cycle are unlikely to be notably different between athletes and the general population. However, energy availability, vitamin D status, plus dermal calcium and sodium losses (from heavy sweating) also have specific relevance to athlete populations and should be considered.[1]

> In the absence of specific guidance for athletes, the calcium intake guidance for the general Australian population is advocated. Indeed, there is no evidence to suggest that exercise and associated elevated metabolism increase calcium requirements. The effect of calcium losses in sweat on calcium balance is unclear but warrants further investigation. Several studies have suggested that the acute loss of calcium in sweat during exercise (cycling) increases parathyroid hormone activity levels to try to defend blood ionic calcium concentrations by increasing calcium resorption from bone. Furthermore, the intake of calcium before/during exercise (≥ 1000 mg) can reduce this effect, potentially defending bone health.[2, 3]

Table 1. Australian Recommended Dietary Intakes (RDI) for calcium

Age Group	Calcium (mg/day)	
	Male	Female
12–18 yrs	1300	1300
19–50 yrs	1000	1000
51–70 yrs	1000	1300
>70 yrs	1300	1300

(National Health and Medical Research Council, 2014)

> Optimal bone health requires weight bearing exercise, a favourable hormonal environment and a complex nutritional support system including adequate energy and calcium intake, plus vitamin D status.

> Calcium requirements are elevated by growth in childhood and adolescence. Inadequate calcium intake during adolescence and early adulthood may lead to sub-optimal bone health due to a failure to gain optimal peak bone mass by ages 25–30. Inadequate calcium intake in adults may lead to exacerbated bone loss.

> Low energy availability (LEA) directly impairs the balance between bone loss and reformation through a disturbance in hormonal equilibrium in athletes.[4] This is more easily identified in female athletes experiencing amenorrhea compared with male athletes. The energy deficiency associated with LEA combined with the hormone disturbance caused by LEA has a further negative effect on calcium balance and bone health[15]. This domino effect coupled with intense exercise inevitably amplifies susceptibility to stress fractures (short-term) and increased risk of osteoporosis (long-term).[5]

> Some athletes are at risk of inadequate calcium status and subsequent poor bone health.

- Athletes with low calcium intakes due to inadequate energy intake, or inadequate intake of dairy and fortified soy products e.g. vegan meal plan with no or limited calcium fortified foods.

- Athletes with poor calcium balance due to undiagnosed/poorly managed conditions involving malabsorption from the small bowel such as coeliac disease and inflammatory bowel disease.
- Athletes with low energy availability due to restricted energy intake and/or high energy requirements.
- Female athletes with impaired menstrual function (i.e. failure to start menses, secondary amenorrhoea, menopause).
- Athletes with high animal protein intake, high oxalate/phytate plant food intake and low calcium intake e.g. commonly seen in diets where grains and dairy are removed.

> Compounding issues that often parallel inadequate dietary calcium intake include inadequate intake of energy and protein, plus impaired vitamin D status, all of which can negatively affect bone health.

> The scientific literature provides unclear findings on the effects of calcium intake/ supplementation on the achievement and maintenance of bone health or the prevention of bone overuse injuries. Several prospective studies in female athletes show that elevated calcium intakes (> 2000 mg/d) enhance bone mineral density and reduce the incidence of stress fractures.[12] The results of retrospective and cross-sectional studies are mixed, however, and there are few studies on adolescent and male athletes.[6]

> Most studies focus on issues of bone health in female athletes due to the well-recognised characteristics of low energy availability and impaired menstrual function associated with relative energy deficiency in sport (RED-S).[4] However, reduced bone density or disturbances in bone health have also been found in male athletes with risk factors including non-weight bearing sporting activities (e.g., cycling, swimming), energy restriction or weight making practices, and low vitamin D status.[1, 7, 8]

What does it look like?

> Approximately two-thirds of the calcium intake of a western diet comes from dairy products, with smaller amounts from bony fish, legumes and certain nuts, plus fortified soy beverages and breakfast cereals. Consumption of vegetarian diets may influence calcium needs because of the relatively high oxalate (e.g. spinach, rhubarb, beans) and phytate content (seeds, nuts, grains, certain raw beans and soy isolates)[9], ensuing intake should exceed that advocated in the relevant RDI. Table 2 provides a list of various foods and their calcium contents.

> Calcium supplements are typically provided in the form of calcium carbonate, although calcium citrate, phosphate and gluconate are also available. Calcium carbonate has the highest percentage of elemental calcium, is generally well tolerated and is well absorbed in doses < 500 mg. Higher absorption from supplemental intakes > 500-600 mg/d can be achieved by splitting the dose over the day. Consuming small doses at mealtimes without the presence of inhibitors, is the best approach for maximising absorption.

> High potency calcium supplements (e.g. Caltrate, which contains 600 mg elemental calcium) typically provide 500-1000 mg per serve.

> Some calcium supplements also provide a source of Vitamin D which may be useful for athletes participating in indoor sports where sun exposure is limited. Caltrate has a product containing 600mg of elemental calcium and 500IU of vitamin D_3.

Table 2. Good sources of dietary calcium.

Food or drink	Serve	Calcium Content (mg)
Cheddar cheese, reduced fat	2 slices (~40g)	400
Tofu, firm	½ cup (~125g)	400
Yoghurt, natural, reduced fat	1 small tub (~200g)	350
Milk, reduced fat	1 cup (250ml)	300
Soy milk, calcium fortified, reduced fat	1 cup (250ml)	295
Oat milk, calcium fortified	1 cup (250ml)	290
Salmon, canned (with bones)	1 small can (~80g drained)	200
Breakfast cereal, calcium fortified	1 cup (~40g)	150-200 (depending on brand)
Bread, calcium fortified	2 slices (~80g)	180
Milo	3 heaped teaspoons (20g)	150
Egg, whole, poached	2 large (~120g)	75
Spinach, baby, steamed	1 cup (~115g)	70 (5% of which is absorbed)*
Almonds (with skin)	20 almonds (~25g)	65
Broccoli, fresh, steamed	1 cup (~155g)	40 (50-60% of which is absorbed)*

* Both of these food items contain high concentrations of oxalate, a compound that reduces calcium absorption[6]

(FSANZ Australian Food Composition Database, 2021)

How and when do I use it?

> Consideration of the need for calcium supplementation should only come after review of current dietary intake. Where dietary calcium intake is considered inadequate, incorporating more calcium rich foods in the meal plan is advocated. For natural food sources of calcium, total calcium intake is of equal or greater importance than bioavailability. The efficiency of calcium absorption varies across foods as calcium may be poorly absorbed from foods rich in oxalates (e.g. spinach, rhubarb, beans) or phytates (seeds, nuts, grains, certain raw beans and soy isolates).[6]

> Sourcing calcium from food is preferred, given increased intake of associated nutrients (which also provide other nutrients) and those at-risk groups should enhance their dietary calcium intake. The exception may be in the management of osteopenia and osteoporosis. In this circumstance, short term calcium supplementation of 500-600 mg of elemental calcium from a calcium carbonate-based supplement may be advocated. A total daily intake of 1300 mg in individuals undergoing drug therapy for osteoporosis regardless of age is recommended.[14]

> Athletes at risk of low energy availability and unable or unwilling to increase overall food intake should also be assessed for adequate calcium intake and supplemented as necessary. Ideally, both overall dietary energy and calcium intakes should be manipulated.

Are there any concerns or considerations?

> Calcium supplementation does not guarantee bone health in the absence of adequate energy availability and associated sex hormone profile, appropriate management of gastrointestinal malabsorption syndromes and weight-bearing exercise.

> Athletes identified with disordered eating or eating disorders require significant treatment to overcome issues relating to long term bone health.

> Both sodium and protein (particularly those high in sulphur containing amino acids) increase urinary excretion of calcium, therefore, it is important to remember that high consumption of both may lead to excess calcium loss.[6] All athletes but especially those that consume mostly a plant-based diet need to be cognisant of the effect sulphur-containing amino acids have on calcium loss, particularly if protein intake is high, because of the exacerbating effects of oxalates and phytates on calcium absorption. The safest approach for minimising protein-induced calcium loss and maximising calcium absorption is for athletes to consume a lacto-ovo-vegetarian diet. In these situations, calcium balance will be optimised by maximising the calcium-to-protein ratio.[6]

> Athletes that continually present with stress reactions or stress fractures should be assessed for malabsorptive conditions such as coeliac disease. For some individuals, bone stress injuries can be the first sign of undiagnosed coeliac disease, particularly in those with no gastrointestinal symptoms.

Where can I find more information?

Sports Dietitians Australia

www.sportsdietitians.com.au/factsheets/fuelling-recovery/bone-health/

Gatorade Sport Science Exchange

www.gssiweb.org/docs/default-source/sse-docs/sale_sse_201_a05_final.pdf?sfvrsn=2

Supplement safety information

www.sportintegrity.gov.au/what-we-do/anti-doping/supplements-sport

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The Australian Institute of Sport (AIS) Supplement Framework is an initiative of the Australian High Performance Sport System. The AIS acknowledges the support of members of the National Institute Network (NIN) and National Sporting Organisations (NSO) and their staff in delivering content expertise. This information is intended to help athletes, coaches and scientists make evidence-based decisions about the use of supplements and sports foods. Before engaging in supplement use, we recommend that each individual refer to the specific supplement policies of their sporting organisation, sports institute or parent body, and seek appropriate professional advice from an accredited sports dietitian (**www.sportsdietitians.com.au**).

Athletes should be aware that the use of supplements may have doping implications. Athletes are reminded that they are responsible for all substances that enter their body under the 'strict liability' rules of the World Anti-Doping Code. Some supplements are riskier than others. The Sport Integrity Australia (SIA) app is a useful resource to help mitigate the risk of inadvertent doping by helping to identify supplements that have been batch-tested. The SIA App provides a list of more than 11,000 batch-tested products. We recommend that all athletes consult the educational resources of SIA regarding the risks associated with supplements and sports foods.. While batch-tested products have the lowest risk of a product containing prohibited substances, they cannot offer you a guarantee that they are not contaminated (**www.sportintegrity.gov.au/what-we-do/supplements-sport**).

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