



# FACT SHEET

## Bone health

Bone is an active tissue that is continually broken down and rebuilt throughout life. The childhood and adolescent years are extremely important for bone health because this is the time when the greatest amount of bone is accumulated. Peak bone mass is achieved between the ages of 20-30 years. Starting in mid-life in men and women, there is a progressive age-related loss in bone mass, which accelerates during the menopausal years in women. This loss in the mass and strength of bone contributes to an increased risk of fracture. Both genetics and lifestyle factors, particularly calcium, vitamin D, and exercise, determine an individual's peak bone mass and their risk of osteoporosis (brittle bones) and fracture later in life.

### What is osteoporosis?

Osteoporosis is a condition where the structure and strength of the bone is weakened, increasing the risk of fractures. In Australia, one in two women and one in three men over the age of 60 will sustain a fracture due to osteoporosis. Currently, the gold standard to estimate bone strength and fracture risk is by measuring bone mineral density (BMD). The lower the bone density, the greater the risk of fractures. In women, bone loss increases rapidly after menopause, when oestrogen levels fall. Because oestrogen protects bone, any time there is a drop in oestrogen bone loss typically follows. This can occur in female athletes who become amenorrhoeic (their periods stop), or in the eating disorder anorexia nervosa. Preventing osteoporosis is about enhancing bone health during growth and preventing bone loss during aging in both men and women. No matter what your age, it is never too late to do something about improving your bone health.

### Genetics and bone health?

Genetic factors play a major role in determining your bone density and level of fracture risk. Even some people who have a high calcium intake and engage in regular physical activity throughout their life can still develop osteoporosis. These people are likely to have a strong family history of osteoporosis, such as a mother or grandmother who may have had a low trauma fracture. People can't change their genetics but they can modify their lifestyle to help prevent osteoporosis (see Table 1).

### Exercise to optimise bone health

The best exercise to improve your bone strength is the type that directly loads the bones through either weight-bearing exercise or strength/resistance training. When you perform these types of activities, bone experiences a load from either the force of the contracting muscle (muscle pull) or from gravity, or both. When there is no force applied to bone, it begins to break down. This occurs during space flight or when someone is confined to bed or immobilized for prolonged periods.

On the other hand, when the loads applied to bone increases, such as during exercise, the strength of the bone increases to cope with the increased demands to prevent them from breaking. In female athletes with amenorrhea however, bone loss can occur due to the absence of estrogen, which plays an important role in regulating bone mass. However, there is some evidence that if the mechanical load is sufficient in these athletes it may protect against bone loss. This has only been shown in sports that generate high forces on bone, such as gymnastics. Sports such as cycling and swimming that are non weight-bearing are less effective at increasing bone mass as there is less force applied to the skeleton.

### What type of exercise works best?

In both pre- and post-menopausal women and older men, strength training appears to be effective for slowing or preventing bone loss at common fracture sites such as the hip and spine. Strength training also offers the advantage of being able to enhance muscle strength and increase or prevent the age-related loss in muscle mass. A 'heavy weights' program (for example, three sets of 8-12 maximum repetitions [3 x 8-12 MR]) is more effective in preventing osteoporosis than a low intensity 'light' weights regime. However, traditional strength training alone does not appear to markedly improve muscle function, such as balance, which is important for preventing falls and fractures. Recent studies indicate that exercise programs focusing specifically on challenging balance exercises or incorporating a combination of strength training with weight-bearing impact exercises and balance activities are most effective for improving or preventing bone loss and optimising muscle mass, strength and functional performance in older people.

#### Table 1: Risk Factors for osteoporosis\*

##### Risk Factors:

**Genetics:** family history (mother or grandmother has osteoporosis). Being Caucasian (fair skinned) or Asian

**Nutritional Factors:** not enough calcium in diet  
High alcohol intake  
Excessive salt (sodium) intake  
Excessive protein intake coupled with poor calcium intake  
Excessive caffeine intake

**Lifestyle Factors:** not enough weight bearing or strength training exercise  
Cigarette smoking

Not enough sunlight/Vitamin D

**Risk factors to refer to your Doctor:** early menopause or ovaries removed

Menstrual cycle is irregular or stopped

Some medications i.e. steroid medication

\*adapted from 'Osteoporosis and young women – making a deposit everyday will secure your future' Arthritis and Osteoporosis Foundation of WA

Previously inactive people interested in starting an exercise program, or any person thought to have osteoporosis or with a history of a recent fracture, should see their GP first before commencing an exercise program. An exercise physiologist or physiotherapist can also help prescribe an appropriate exercise program to suit your needs and prevent injury.

### How much exercise is recommended?

The precise amount of exercise to prevent osteoporosis is not known, but the type and amount recommended will vary according to age, bone density and fracture risk. For most individuals without osteoporosis or a history of fracture, regular weight-bearing exercise (brisk walking, jogging, step-ups, tennis etc.) and/or strength training for 30-60 minutes at least three times per week can slow or prevent bone loss. For maximal skeletal benefits, all exercise programs should become progressively more difficult over time, and specifically target the major muscle groups attached to or near the hip, spine and forearm.

- For weight-bearing exercises, 50 to 100 moderate impact jumps per session, which can be divided into discrete bouts of 10 to 20 jumps, performed 3 to 5 times per week, is recommended.
- For strength training, moderate to high intensity programs (3 sets x 8-12 maximum repetitions) targeting the key muscles of the hip, spine and forearm are most effective.

For the frail elderly and individuals with osteoporosis or a recent fracture, the primary focus of an exercise program should be to prevent falls and fractures. Thus, moderate to high challenging balance training programs are currently recommended.

### Effects of amenorrhea on bone

There is considerable evidence showing that amenorrhea in female athletes is associated with reduced bone mass, and a history of regular menstrual disruptions can lead to a failure to attain peak bone mass. Thus, early intervention is recommended to minimise the risk of osteoporosis later in life. Amenorrhea appears to affect non-weight bearing bones (arms) to a greater extent than weight-bearing bones (hip). This may be because exercise offers some protection against bone loss at weight-bearing sites. A study in gymnasts and runners with a similar prevalence of menstrual problems found gymnasts had a higher BMD in the femur (upper leg bone) than the runners. Higher impact forces from the gymnastics training were thought to account for the differences and protect against bone loss.

### What is the role of calcium in preventing osteoporosis?

Calcium needs are based on the amount of dietary calcium that will maintain calcium balance and optimize bone health. The current Australian RDI for calcium is 1000 mg/d for women aged 19 to 50 years and 1300 mg/d for women aged over 50 years. For men, the recommended intake is 1000 mg/d up to the age of 70 years, and 1300 mg/d thereafter. In athletes with amenorrhoea, 1500 mg of calcium daily is recommended. Other nutritional factors, such as salt (sodium), excessive protein and caffeine, can increase the loss of calcium in the urine but have the most affect when the person has a poor calcium intake (or negative calcium balance). A high calcium intake with meals can reduce iron absorption; therefore athletes with high iron requirements shouldn't take prescribed calcium supplements with meals.

### What are the best sources of calcium?

The calcium content of various foods are shown in Table 2. Dairy foods are the major source of readily absorbed calcium. Milk contributes over half of the calcium intake in men and women, while yoghurt accounts for around one third of the calcium intake. People unable to eat enough calcium can use calcium supplements. Calcium supplements are best taken at bedtime or in between meals. The absorption of calcium is most effective when the supplement is taken in doses of 500 mg or less.

Table 2: Calcium content of foods\*

Food	Serve size	Calcium (mg)
Whole milk	1 cup	295
Skim milk	1 cup	320
Calcium fortified milk	1 cup	415
Buttermilk	1 cup	375
Reduced fat milk	1 cup	350
Calcium fortified soy drink	1 cup	275
Yoghurt	200g tub	300
Yoghurt, reduced fat	200g tub	340
Cheese, cheddar	1 slice (20g)	155
Cheese, reduced fat	1 slice (20g)	160
Ricotta cheese, reduced fat	100g	245
Cottage cheese	100g	70
Ice cream, reduced fat	2 scoops	26
Custard	1 cup	250
Salmon w bones	100g	375
Tahini, sesame butter	20g	66
Parsley	20g	50
Almonds	20g	6
Bean curd (tofu)	100g	330
Spinach	100g	60

\* source: AUSNUT 1999

### Importance of Vitamin D

Adequate vitamin D is important for active calcium absorption in the gut and both bone and muscle health. Low vitamin D levels are associated with osteoporosis, falls and fractures. The main source of vitamin D is sunlight exposure. It is difficult to get enough vitamin D from diet alone because few foods naturally contain vitamin D (fish, eggs, margarine and some types of milk have added vitamin D). To get enough sun exposure to produce vitamin D, it is recommended that a person needs to exposure their hands, face and arms (or a similar area) to the sun for around 6-8 minutes, 4-6 times a week, just before 10am or just after 3pm in summer. During winter longer exposure times are needed depending on location. For the elderly or those who have limited sun exposure, supplementation with vitamin D should be considered.

### Summary Points

- Regular weight-bearing activity and strength training are both effective for improving bone health. Activities such as cycling and swimming, although excellent for aerobic fitness, don't increase bone mass.
- Maintaining a diet rich in high calcium foods and ensuring adequate sun exposure to optimise vitamin D levels, are both important to optimise bone health. Avoid excess salt, protein and caffeine-containing food and drinks as they can increase calcium losses.
- People with osteoporosis need to take extra care when exercising, but should be encouraged to improve their balance and muscle function to prevent falls and fractures.
- Female athletes with amenorrhoea for longer than six months, a history of anorexia nervosa, or a history of stress fractures, may require routine screening for bone mineral density.