

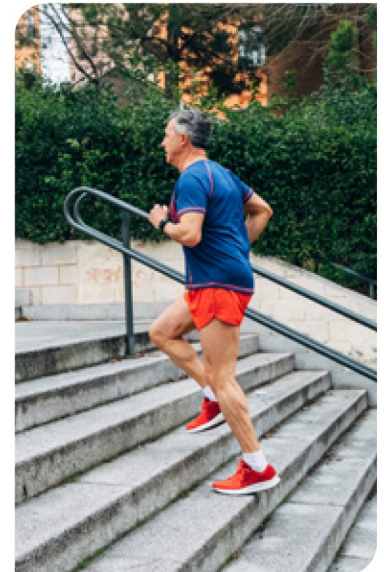
OSTEOPOROSIS AND EXERCISE

WHAT IS OSTEOPOROSIS?

Osteoporosis is a condition of low bone mass that leads to increased risk of fracture. The spine, wrist, hip, humerus and ribs are the most common fracture sites but any bone can be affected. Of Australians over 50, 66% have low or very low bone mass; 42% of women and 27% of men will fracture. The financial costs of osteoporotic fracture are around \$3 billion per year and the personal costs in reduced quality of life are immense. Fewer than 50% of individuals who suffer a hip fracture regain their previous level of function.

WHAT CAUSES OSTEOPOROSIS?

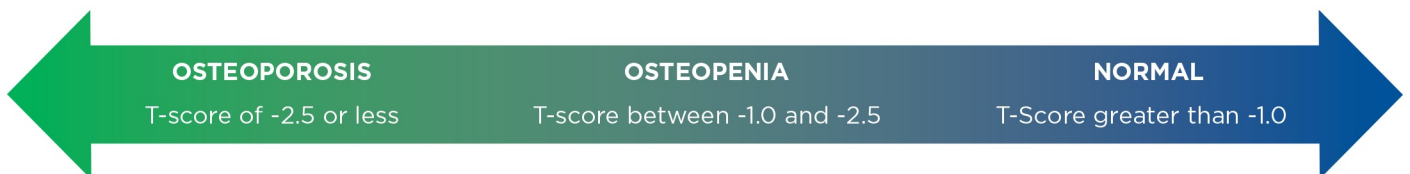
Heredity and a tendency to lose bone as we age are the primary causes of osteoporosis. Gradual bone loss begins around early middle age. The rate of loss accelerates for women at the time of menopause as oestrogen is a highly influential hormone for bone. Immobilisation and certain medical conditions, or their treatments (e.g. corticosteroids), increase bone loss. Inactivity, inadequate dietary calcium and vitamin D, smoking and alcohol increase the risk of osteoporosis. Loss of muscle strength and balance with age and disuse increase the risk of falls that cause osteoporotic fractures.



HOW IS OSTEOPOROSIS DIAGNOSED?

Low bone mass often remains undetected until a person suffers a fracture. The standard method to diagnosis osteoporosis is dual-energy x-ray absorptiometry (DXA), a very low-dose x-ray examination. Scans are usually performed at the hip and spine and provide a T-Score which indicates how an individual's bone mass compares to a reference database. The T-score is then used to describe a person as having 'normal', 'osteopenic' or 'osteoporotic' bone. While risk of fracture is greatest in those with lowest bone mass, the majority of fractures actually occur in osteopenia simply because it is more common than osteoporosis.

BONE MASS CLASSIFICATIONS BY DXA T-SCORE



HOW DOES EXERCISE INFLUENCE BONE?

Bone has a remarkable ability to adapt in response to changes in loading in order to protect it from damage (such as when a person begins to exercise having been sedentary, or increases or modifies their exercise regime). It does this by bending slightly more or differently than usual under the novel loading, which sends signals to the bone cells embedded in the tissue. Those signals stimulate bone resorption and formation to modify bone density, shape and size in a way that future bending under the same load is minimised. When a bone has changed its size or shape to the extent that the same loading no longer invokes the same degree of bending, it ceases to change. Varying the types of loading (doing different activities) is therefore an important strategy to ensure that exercise continues to be a positive stimulus for bone.



WHAT EXERCISE IS BEST FOR OSTEOPOROSIS?

WEIGHT-BEARING EXERCISE: Bone is lost when immobilised or chronically disused. Bed rest and wheelchair confinement cause the most dramatic bone losses in the lower extremities and spine, but a highly sedentary lifestyle can be equally detrimental in the long term. As spine and hip fractures are common sites of osteoporotic fracture, weight-bearing exercise is particularly important. The maximisation of bone mass in throughout the lifespan requires engagement in a wide variety of weight-bearing activities that will impart high impact forces on the bones. Examples of weight-bearing impact activities that are appropriate for children and physically able adults (not frail or osteoporotic) are included in column 1 of the table below.

A person with low bone mass who is highly deconditioned or frail (“high risk”) will not immediately tolerate high impact weight-bearing activities. In those cases, lower impact activities are an appropriate place to begin (column 2 of the table). In fact, although high risk individuals are traditionally managed very conservatively, with gradual introduction and strict supervision, limitations of muscle weakness and joint pain can be addressed and much can be gained from more challenging weight-bearing exercise. As a general rule for bone, time spent sitting and lying down during the day should be minimised.

RESISTANCE TRAINING: High intensity resistance training (80-85% 1RM) is required to stimulate notable bone adaptation, and free weights are better than machine-based to facilitate weight-bearing loading. Even high risk individuals can strive for high intensity resistance training but should only do so with full supervision from an accredited exercise physiologist/ physiotherapist with the appropriately graduated increments. (As a percentage of an individual's maximum capacity, 85% 1RM is self-limiting.) The timeline of progression should be very slow with the focus on mobility and technique. Exercises to strengthen the back and leg muscles are particularly beneficial. Deep forward flexion, particularly loaded, should be avoided.

BALANCE TRAINING: While unlikely to improve bone mass, balance exercises will improve lower extremity neuromuscular function and thus prevent falls. Balance training is recommended at all ages but is particularly important for older adults. Weight-bearing activities that challenge balance such as Tai chi, line and ballroom dancing, heel-to-toe walking on foam mats raising the arms above the head, stepping sideways over objects, walking on tip toe and multi-tasking (e.g. standing in tandem stance and catching a ball) are beneficial. A minimum of 2 hours balance training per week is recommended.

KEY CONSIDERATIONS

- The key to effective exercise for osteoporosis is supervision by trained experts
- Use it or lose it - gains in bone, muscle and balance from exercise will be lost if the exercise is stopped
- High intensity resistance training should not be attempted with uncontrolled cardiovascular disease
- Activities that involve notable twisting (golf) or abrupt unusual movements (squash) may cause fractures in a frail skeleton
- Pain beyond general muscle soreness after exercise should be investigated by a medical professional

OSTEOGENIC EXERCISE FOR ANY AGE WITH NORMAL BONE MASS	INTRODUCTORY EXERCISES FOR THOSE WITH FRAILITY AND/OR LOW BONE MASS (“HIGH RISK”)
Aim for a variety of exercises 4 times per week, 30 mins per day: • Running (emphasise speed rather than duration) • Jumping (all directions) • Hopping (all directions) • Skipping • Stair running and jumping • High impact aerobics • High intensity (80-85% 1RM) resistance training • Volleyball, basketball, netball, ballet, tennis, squash, racquetball, football, field hockey	MUST be supervised by a qualified exercise professional. Aim for a variety of exercises 2 times per week, 30 mins per day (in addition to balance training described above). • High intensity (80-85% 1RM) weight-bearing resistance training (esp. back and leg exercises) • Graduated impact activities such as heel drops and foot stamps • Stair climbing and descending • Mobility exercises

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REFERENCES AND FURTHER INFORMATION

Exercise is Medicine Australia
www.exerciseismedicine.com.au
Exercise Right www.exerciseright.com.au
Find an AEP www.essa.org.au
Find a Physio www.choose.physio

If you have any concerns about the safety of your patient in commencing an exercise program, please consider referral to a Sport and Exercise Physician.
Find a Sport and Exercise Physician www.acsep.org.au/

1. Beck BR, Daly RM, Fiatarone-Singh MA, Taaffe DR: Exercise and Sports Science Australia (ESSA) position statement on exercise prescription for the prevention and management of osteoporosis. J Science Med Sport 20(5): 438-445, May 2017
2. Watson SL, Weeks BK, Weis L, Horan SA, and Beck BR: High-Intensity Resistance and Impact Training Improves Bone Mineral Density and Physical Function in Postmenopausal Women With Osteopenia and Osteoporosis: The LIFTMOR Randomized Controlled Trial. J Bone Miner Res, 2018 Feb;33(2):211-220.
3. Sherrington, C., et al., Effective exercise for the prevention of falls: a systematic review and meta-analysis. J Am Geriatr Soc, 2008. 56(12): p. 234-43.
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