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Part 1 of this guide outlines the principles of exercising to enhance bone health and help prevent osteoporotic fractures. Part 2 provides exercises to improve bone health and help prevent fractures.
1. EXERCISE GUIDELINES

As we age our bones lose minerals and can become weak and brittle, causing the condition called osteoporosis. The best way to enhance bone health and prevent fractures due to osteoporosis is a combination of exercise, adequate nutrition and, when required, medication. In middle aged and older people, rapid, short bursts of high intensity activity have been shown to improve the density of bone and the strength of muscles more effectively than other forms of exercise. This exercise can be done in structured classes or in the home.

The principles of exercising to promote bone health described in this guide are relevant for healthy adults and for those with osteoporosis or other medical conditions. However, if you have osteoporosis or any other medical conditions you should see your General Practitioner (GP) or Health Professional (HP) for guidance on exercises suited to your needs.

TYPES OF EXERCISE THAT PROMOTE BONE HEALTH

Weight-bearing aerobic exercise

Weight-bearing exercises are those that use the large muscle groups in a rhythmic pattern and are performed in a standing position. These exercises should be done at a rate that increases your heart rate, blood pressure and breathing to at least a ‘moderately hard’ level. Examples are brisk walking, hiking, stair climbing, jogging and aerobic dance. Swimming, cycling, seated exercises and arm exercises are nonweight-bearing aerobic exercises and have little effect on bone health. Aerobic exercise is also known as endurance or cardiovascular exercise.

Resistance training

Resistance training is also known as strength training or weight lifting. It is the use of targeted muscle groups to lift and lower moderate to heavy weights. In traditional weight lifting, the weight is lifted and lowered slowly; in power training, it is lifted as fast as possible and then lowered slowly. Exercises can be machine-based (e.g. leg press, seated rowing, pulldown and knee extension) or done using free weights, i.e. dumbbells or ankle weights (e.g. knee extension and flexion, hip extension, flexion and abduction, leg raises, shoulder strengthening, biceps curl and triceps lift).

Figure 1. Weight lifting improves bone health. Exercises can be done on weight machines (such as the leg press) or using free weights (dumbbells and ankle weights).
High impact exercise
In high impact exercise, the bones of the spine and legs incur high stresses as the feet hit the ground. Examples include skipping with a rope, jumping or hopping (including up and down stairs and on and off boxes) and sports involving jumping, such as basketball and netball. Fast heel drops (fast drop of the heel over the edge of a step, with a sudden stop, then slow raise) are a more suitable form of high impact exercise if you have had a previous injury or have osteoarthritis of the knees or hips.

Figure 2. High impact exercise has recently been shown to be particularly beneficial to bone health. Jumping up and down stairs is an example of a high impact activity.

Balance training
Balance exercises stress the body’s sense of balance by decreasing foot contact with the ground, changing the centre of mass and removing vision. Examples include standing on one leg with eyes closed, sitting on an exercise ball, heel-to-toe walking (heel of one foot directly in front of the toes of the other foot, so they touch or almost touch), stepping sideways over an object, leaning as far as possible in all directions while standing without bending at your waist, tai chi and balancing while placing a pillow or rocker board under your feet.

PRINCIPLES OF EXERCISING TO ENHANCE BONE HEALTH

• Short bursts of high intensity and/or high impact activities such as jogging, jumping and skipping are more stimulating to bone than sustained, low impact activities such as walking. The higher the impact, the greater the benefit to the bones.

• Exercise has to get progressively harder to continue to improve bone health. Over time the weights lifted need to be heavier, the incline of walking or jogging steeper, the height of jumps greater and the difficulty of balance exercises more challenging (e.g. by removing hand support).

• Exercise does not have to be weight-bearing to enhance bone health. Resistance training done in the sitting or lying position (nonweight-bearing) improves bone health. However, aerobic activities that are nonweight-bearing (such as swimming or cycling) have little effect on bone health although they are good for aerobic fitness.

• Lifting heavy weights improves bone health more than lifting light weights.

• Rapid movements are more stimulating to bone than slow movements. Lifting heavy weights rapidly (power training) seems to be more effective than lifting heavy weights slowly (traditional resistance training).

• Exercise involving changes of direction and different height jumps is more stimulating to bone than exercise involving repetitive actions.

• Exercising in short bouts with rest periods between seems to improve bone strength more effectively than continuous, long periods of exercise.
EXERCISE & OSTEOPOROTIC FRACTURE PREVENTION

- Muscles connected to bones that are prone to osteoporotic fracture (i.e. bones of the hip, wrist and thoracic spine) need to be strengthened to achieve protection for those bones.
- Balance training improves mobility and confidence, reducing falls and the fear of falling.

GUIDELINES FOR RESISTANCE TRAINING USING FREE WEIGHTS

Equipment
You will need a set of ankle cuffs with removable 0.5kg weights. Have a total of 10kg per leg. Also have a set of adjustable dumbbells or fixed weight dumbbells of various sizes ranging from 1kg to about 20kg. You will also need a sturdy chair with a straight high back and no arms.

Muscle groups
The major muscle groups to target in a balanced resistance training program are the arm muscles (biceps and triceps), upper torso muscles, lower abdomen muscles, muscles around the hip, thigh muscles (quadriceps and hamstrings) and calf muscles. Physiotherapists and qualified fitness trainers can also give you advice on exercises and may run suitable programs.

Amount and frequency
Exercise two or three times per week, with at least one day of rest between sessions. Do two or three sets of eight repetitions of each exercise per session, with at least one minute of rest between sets. Each session should take 30 to 45 minutes. Keep a record of each session (date, exercises performed, weights used and numbers of repetitions done).

Technique
Breathe out as you lift a weight and in as you lower it; don’t hold your breath. Perform each movement slowly, through the full range of motion, taking about 6 to 9 seconds for each repetition and 2 to 3 seconds of rest between lifts. Don’t swing the weight or use momentum to complete the lift.

Progression
For effective resistance training, the weight should feel hard to lift. As soon as lifting the weight for two sets no longer feels hard, move up to the next weight.

Enhancing balance
If necessary, hold on to the back of the chair for support during weight lifting exercises performed in the standing position, such as hip extension, flexion and abduction. As your balance improves, progress from using two hands on the chair to one hand, one fingertip, no hands, and then no hands and eyes closed.

Figure 3. Hip extension is one of the several exercises done to strengthen the muscles in the lower back–hip–thigh region, so as to protect the bones of the hip from osteoporotic fracture.


Enhancing bone growth and strength

The rest period between sets of weight lifting exercises can be used for high impact exercise. For example, perform one jump between each set, aiming for a total of about 20 to 60 jumps per week. If wearing ankle weights, keep them on for the jump.

EXERCISING WITHOUT ANY EQUIPMENT

You can incorporate balance and high impact exercises into your daily activities if you don’t have access to weight lifting and other equipment. Some simple exercises are listed here.

- Stand on one leg whenever you are standing at a sink or counter or in a queue.
- Walk heel-to-toe between rooms (place the heel of one foot directly in front of the toes of the other foot, so that they touch or almost touch).
- Stand up and sit down slowly without using your arms.
- Squat to pick up items or reach into low shelves or drawers, rather than bending over.
- Jump up and down steps and stairs using both feet to land; advance to one leg hops. If your balance is poor, start by holding on to a railing.
- Lift items with one hand instead of both.
- Avoid having poor posture, particularly forward flexion of the spine. To improve your sitting posture, sit on a Swiss ball or a backless chair.

BE CAREFUL

- If you have osteoporosis or any other medical conditions, consult your general practitioner before beginning an exercise program.
- If you have poor balance or a history of osteoporotic fracture, you will require specific exercise programs for enhancing bone health and you should always exercise under supervision.
- Exercise under supervision at least until you are sure your technique is correct.
- Everyone at risk for osteoporotic fracture should avoid physical activities involving forward bending of the spine, particularly while carrying an object, because of the risk of compression fractures of the vertebrae. These activities include sit-ups with straight legs, lawn bowls and simply bending over to pick up something from the floor.
- Avoid physical activities that are associated with a high risk of falls.
- Avoid hazardous environments that may lead to falls.

Figure 4. Balance exercises such as heel-to-toe walking (right) and side stepping (far right) improve mobility and confidence, reducing both falls and the fear of falling.
2. EXERCISES

This section provides some exercises that, if performed regularly, will improve the health of your bones and help prevent osteoporotic fractures.

To improve strength, balance and bone density, it is important that each exercise you do feels ‘hard’ (scoring at least 15 on the scale of perceived exertion – see below).

Also, make sure you are doing each exercise properly – the correct and incorrect techniques are highlighted on the following pages.

EXERCISE INTENSITY SCALE

- At each exercise session, rate the difficulty of the first time you do each exercise on this scale.
- When your rating for an exercise falls below a score of 15, increase the difficulty by moving up to the next higher weight, decreasing the hand support (from two hands to one hand, to one finger, to one fingertip to no hands), standing on one leg or jumping higher, depending on the exercise.

EQUIPMENT – WHAT YOU WILL NEED

You will need the following equipment for the strength training exercises:

1. A set of ankle cuffs with removable 0.5kg weights (a total of 10kg per leg).
2. A set of adjustable dumbbells or fixed weight dumbbells ranging from 1kg to about 20kg.
3. A sturdy chair with a straight high back and no arms.
Putting on the ankle cuffs
(Photo 1)
Sit on a chair and place each foot on a step so you can easily reach each ankle to fasten the cuff without having to bend forward.
Forward bending of the spine can cause compression fractures of the vertebrae in people at risk of osteoporosis.

STRENGTH TRAINING EXERCISES
You should do two or three sets of eight repetitions of each exercise per session, and two or three sessions per week. In the rest period of at least a minute between each set, you should do one jump or heel drop (see photo 14).
Each session should take 30 to 45 minutes. Each of the exercise descriptions below counts as one repetition.

Calf raise
(Photos 2a, 2b and 2c)
**Strengthens the ankle and the calf muscles.**
1. Wearing ankle weights, stand holding the back of a chair.
2. Lifting your heels, rise up on the toes of both feet, as high as possible.
3. Hold, then slowly lower your heels.
4. When this is too easy, use one leg at a time, alternately (photo 2c).

Knee flexion
(Photos 3a and 3b)
**Strengthens the hamstring muscles, which bend the knee.**
1. Wearing ankle weights, stand holding the back of a chair, close to it.
2. Bend one knee and slowly lift this foot backwards to as close to the back of your thigh as possible. Keep the upper part of your leg still, and your body upright.
3. Hold, then slowly lower your leg.
4. Repeat for the other leg.
EXERCISE & OSTEOPOROTIC FRACTURE PREVENTION

Hip abduction
(Photos 4a and 4b)
Strengthens the muscles that pull the legs out to the side.
1. Wearing ankle weights, stand holding the back of a chair, close to it.
2. Without bending your knee or waist, move one leg straight out to the side, keeping your toes pointing forwards.
3. Hold, then slowly lower your leg.
4. Repeat for the other leg.

Hip flexion
(Photos 5a and 5b)
Strengthens the muscles that bring the knee towards the chest.
1. Wearing ankle weights, stand side on to the back of a chair, resting one hand on the chair back.
2. Without bending at the waist or letting go of the chair, bring one knee at a time as close to your chest as possible.
3. Hold, then slowly lower your leg.
4. Repeat for the other leg.
**Hip extension**  
*(Photos 6a and 6b)*  
*Strengthens the muscles in the buttocks and lower back.*  
1. Wearing ankle weights, stand holding on to the back of a chair, and bend forward about 45 degrees at the waist.  
2. Slowly lift one leg straight out behind you as high as possible. Keep your knee straight and foot pointing downwards, and don’t move your upper body.  
3. Hold, then slowly lower your leg.  
4. Repeat for the other leg.

![Hip extension images](image-url)

**Knee extension**  
*(Photos 7a and 7b)*  
*Strengthens the quadriceps muscle, which straightens the knee.*  
1. Wearing ankle weights, sit in a chair with a good upright posture and the back of your knees resting against the chair seat.  
2. Raise one foot in front of you until your knee is as straight as possible, keeping your thigh on the chair and your toes pointing up. Pull your toes towards your head as far as possible.  
3. Hold, then slowly lower your leg.  
4. Repeat for the other leg.
Leg lifts

*(Photos 8a, 8b and 8c)*

**Strengthens the abdominal muscles to improve posture.**

1. Wearing ankle weights, sit in a chair and slide forwards so your buttocks are near the front edge and your back is resting against the chair back. Hold on to the sides of the seat for balance.
2. Slowly lift both feet 5 to 10cm off the ground, then straighten your legs out in front of you.
3. Hold, then slowly lower your feet to the ground.
4. If this is too difficult, remove the weights or lift one leg at a time.

Seated row

*(Photos 9a and 9b)*

**Strengthens the muscles of the upper torso for control of balance and posture.**

1. Holding dumbbells, sit forward in a chair with a good upright posture.
2. Hold the dumbbells perpendicular to the ground with elbows bent, so that the dumbbells are touching each other about 10cm in front of your chest.
3. Slowly bring your arms out to the side as though you are drawing a circle around your body. Try to squeeze your shoulder blades together.
4. Bring your arms back directly in front of your chest.
**Biceps curl**  
*(Photos 10a and 10b)*  
*Strengthens the upper arm muscles that flex the elbow.*  
1. Holding dumbbells, sit in a chair with a good upright posture.  
2. Bend one elbow to lift the dumbbell towards your shoulder.  
   Don’t move the upper arm or shoulder during the lift.  
3. Hold, then slowly lower the dumbbell.  
4. Repeat for the other arm.

![Biceps curl images](10a.png) ![Biceps curl images](10b.png)

**Triceps lift**  
*(Photos 11a and 11b)*  
*Strengthens the muscles at the back of the upper arm that straighten the elbow.*  
1. Sit in a chair with a good upright posture, arms by your side.  
2. Holding a dumbbell in one hand, raise that arm over your head.  
   Using your other arm to hold your elbow close to your ear, slowly bend the elbow  
   so the dumbbell moves down to behind your neck.  
3. Slowly raise your arm straight above your head.  
4. Hold, then slowly bend your elbow to lower the dumbbell back behind your neck.  
5. For this exercise, do all the repetitions for a set with one arm before changing to the  
   other arm (i.e. eight times with one arm, then eight times with the other arm).

![Triceps lift images](11a.png) ![Triceps lift images](11b.png) ![Incorrect triceps lift](Correct.png)
**Overhead press**  
*(Photos 12a and 12b)*  
*Strengthens the shoulder and upper arm muscles.*  
1. Holding dumbbells, sit in a chair with a good upright posture, arms by your side.  
2. Raise both arms, bending the elbows so the dumbbells are held level with your ears.  
3. Slowly raise both arms straight above your head.  
4. Hold, then slowly lower your arms to level with your ears.

**Side arm raise**  
*(Photos 13a and 13b)*  
*Strengthens the deltoid muscles that lift the arms out to the side.*  
1. Holding dumbbells, sit in a chair with a good upright posture, arms by your side.  
2. Raise your arms out to the side as high as your shoulders, keeping the elbows straight.  
3. Slowly lower your arms to the chair.

**Jump**  
*(Photo 14)*  
*High impact exercise stimulates bone cells, increasing bone density.*  
Perform one jump in the rest period between each set of each strength training exercise – so you do about 15 to 30 jumps per session. Land with your knees straight and on both feet.  
If you have previous injuries or more than mild knee or hip osteoarthritis then heel drops are more suitable. For heel drops, stand on a step with your heels overhanging the edge. Rapidly drop your heels, with a sudden stop. Then slowly raise them.
BALANCE EXERCISES
Balance exercises are best done before strength training exercises to minimise fatigue and the risk of falling. You should do one set of five repetitions of each exercise per session.

Tandem walking
(Photo 15)
Also known as heel-to-toe walking.
1. Walk for 3 to 4 metres placing the heel of one foot directly in front of the toe of the other, just touching.
2. Have a chair, rail or another person close by in case of overbalancing.

Crossover walking
(Photo 16)
1. Walk sideways for 3 to 4 metres crossing one leg in front of the other, placing your feet parallel to each other with the toes level.
2. Have a chair, rail or another person close by in case of overbalancing.

Sideways stepping over object
(Photo 17)
1. Walk sideways over three or four objects of differing heights, placing your feet parallel to each other with the toes level.
2. Have a chair, rail or another person close by in case of overbalancing.

Standing on one leg, eyes closed
(Photo 18)
1. With your eyes closed and one hand resting on the back of a chair for support, stand on one leg for 30 seconds.
2. Repeat for the other leg.
3. To increase difficulty, add a mental task such as naming animals or subtracting 7’s from 200.
4. To further increase the difficulty, reduce the hand support from one hand to one finger to one fingertip to no hands.
EXERCISE & OSTEOPOROTIC FRACTURE PREVENTION

HEALTH PROFESSIONAL GUIDES

CONSUMER GUIDES

FOR MORE INFORMATION

• Osteoporosis Australia – www.osteoporosis.org.au
• Fit For Your Life Foundation – www.fitforyourlife.org
• Centre for Strong Medicine, Balmain Hospital, Sydney – www.strongmedicine.md
• COTA (Council on the Ageing): Living Longer Living Stronger program – www.cota.org.au

5 FACT SHEETS IN 5 LANGUAGES (PLUS ENGLISH):
CHINESE, VIETNAMESE, ARABIC, GREEK AND ITALIAN
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