

## 6 Osteoporosis and fractures

Osteoporosis (meaning ‘porous bones’) is a condition in which the bones weaken and lose structural integrity, resulting in high risk of fracture. People with osteoporosis may have substantially decreased bone mass, clinically defined as bone mineral density (BMD) a certain amount below the average level in young adults. The decrease in bone mass makes the bones more fragile and they are broken more easily than bones of ‘normal’ mass.

A major feature of osteoporosis is fractures that occur following little or no trauma, known as ‘minimal trauma fractures’. These fractures may affect bodily movement and functioning, which can result in disability, affect social interaction and quality of life, and lead to a loss of independence. Hip fractures in older people are a common result of longstanding osteoporosis and are associated with high levels of morbidity and increased mortality.

This chapter provides an overview of the nature, impacts and treatment of osteoporosis. It also describes some of the more common osteoporotic fractures, and outlines various fracture prevention strategies.

### PREVALENCE AND DETECTION OF OSTEOPOROSIS

Self-reported data indicate that almost 581,000 Australians have been diagnosed with osteoporosis, with the vast majority being over 55 years of age. Women are much more likely to report osteoporosis than men. However, osteoporosis has no outward symptoms, and people often do not know that they have the condition until a fracture occurs. It is believed that the number of people who have osteoporosis, and who are therefore at high risk of fracture, is much larger than the estimates obtained from self-reported information.

Osteoporosis is most commonly diagnosed when a person visits a doctor, clinic or hospital following a minimal trauma fracture (also known as a ‘low-impact fracture’, ‘fragility fracture’ or ‘osteoporotic fracture’). This is a fracture sustained in an event which would not be expected to fracture a healthy bone—for example, a trip and fall while walking. Some of the more common osteoporotic fracture sites are the hip, wrist and spine.

Osteoporosis may also be diagnosed by measuring bone mineral density (Box 6.1). However, not all people with low bone mineral density will experience minimal trauma fractures, and vice versa. Factors that increase the risk of fractures are discussed later in this chapter.

The turnover of bone causes various molecules (such as osteocalcin) to be released into the bloodstream or excreted in the urine. Although they are not specific enough to be used alone as a diagnostic tool, some of these biochemical ‘markers’ can be useful in determining the rate of bone loss or bone formation, which can help to estimate a person’s risk of osteoporosis or assess their response to treatment (Sambrook et al. 2002).

**Box 6.1: Diagnosing osteoporosis using bone mineral density testing**

The 'gold standard' method for measuring bone mineral density (BMD) is dual-energy X-ray absorptiometry, also known as DXA or DEXA. Low-dose X-ray beams are aimed at the bones, and bone density can be determined from the amount of X-rays that are absorbed. This is the most common method used in clinical practice, with measurements usually taken at the hip and/or spine.

BMD results can be divided into three categories:

- **Normal:** BMD less than 1 standard deviation below the average BMD in young adults of the same sex.
- **Osteopenia (literally 'poor bones'):** BMD between 1 and 2.5 standard deviations below the average BMD in young adults of the same sex.
- **Osteoporosis:** BMD more than 2.5 standard deviations below the average BMD in young adults of the same sex.

Other methods used for measuring BMD include quantitative computed tomography (QCT) and quantitative ultrasound (QUS). QUS is the screening test often seen at pharmacies or shopping centres, where the measurement is taken at the heel. This test can help to identify persons who might need further investigation, but is not used alone for diagnosis or monitoring as its responsiveness to therapy or change over time is uncertain.

Source: WHO Scientific Group 1994.

## Osteoporotic fractures

Almost any of the body's 206 adult bones can be affected by osteoporosis, and therefore more easily fractured than would normally be the case. However, fractures are more likely to occur at some sites than at others. The most common fractures in people with osteoporosis include bones that are under strain because they bear weight (such as the spine, pelvis and hips) or that take the stress when a person catches him- or herself when falling (such as the wrists, forearms and upper arms). Some features of these common fracture sites are described below.

### Hip and pelvis

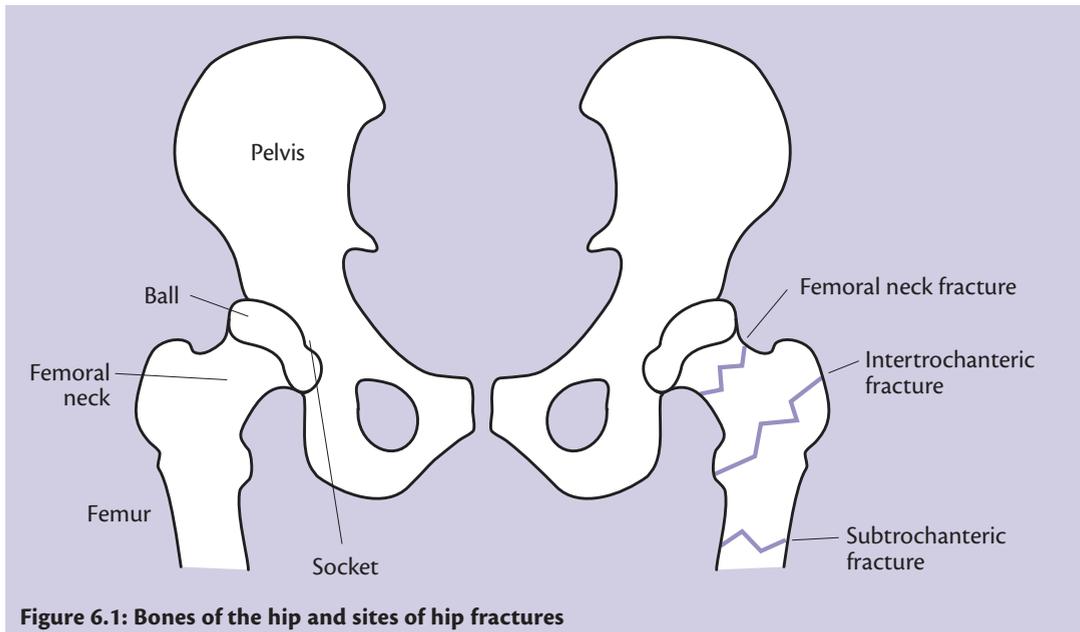
The hip joint is an example of a ball-and-socket joint, the most mobile type of joint in the body. At the upper end of the femur (thigh bone) the bone projects inward and forms a ball (Figure 6.1). This ball sits inside a cup-like socket at the side of the pelvis, and allows a wide range of movements of the legs.

The two most common types of hip fractures, as shown on the right side of Figure 6.1, are:

- **femoral neck fractures**, occurring in the narrow section of bone between the main shaft of the femur and the ball
- **intertrochanteric hip fractures**, where the shaft of the femur breaks just below the femoral neck.

Fractures may also occur slightly further down the shaft of the femur; these are known as subtrochanteric fractures and are less common.

Fractures to the hip or pelvis are normally caused by a fall, but may also result from impact to the hip. In people whose bones are weakened from osteoporosis, relatively minor impacts (such as bumping into a piece of furniture) may be enough to cause a hip fracture. This type of fracture is the most serious osteoporotic fracture, and has the most complications.



**Figure 6.1: Bones of the hip and sites of hip fractures**

### Wrist and forearm

Falls are the most common cause of fractures of the wrist and forearm, both in people with osteoporosis and in people with normal bone density. The sudden force applied when a person catches him- or herself after a fall puts great stress on the bones in this region, and can cause one or more of them to fracture. However, the severity of fall required to cause a wrist or forearm fracture in a person with osteoporosis is much less than in a person with normal bone density, due to the greater fragility of the bones.

The two most common types of wrist fracture are:

- **Colles' fracture**—this is a fracture to the lower end of the radius, and very common in people with osteoporosis.
- **Scaphoid fracture**—the scaphoid is a wedge-shaped bone located on the thumb side of the wrist, just where it meets the radius. These fractures are less commonly related to osteoporosis.

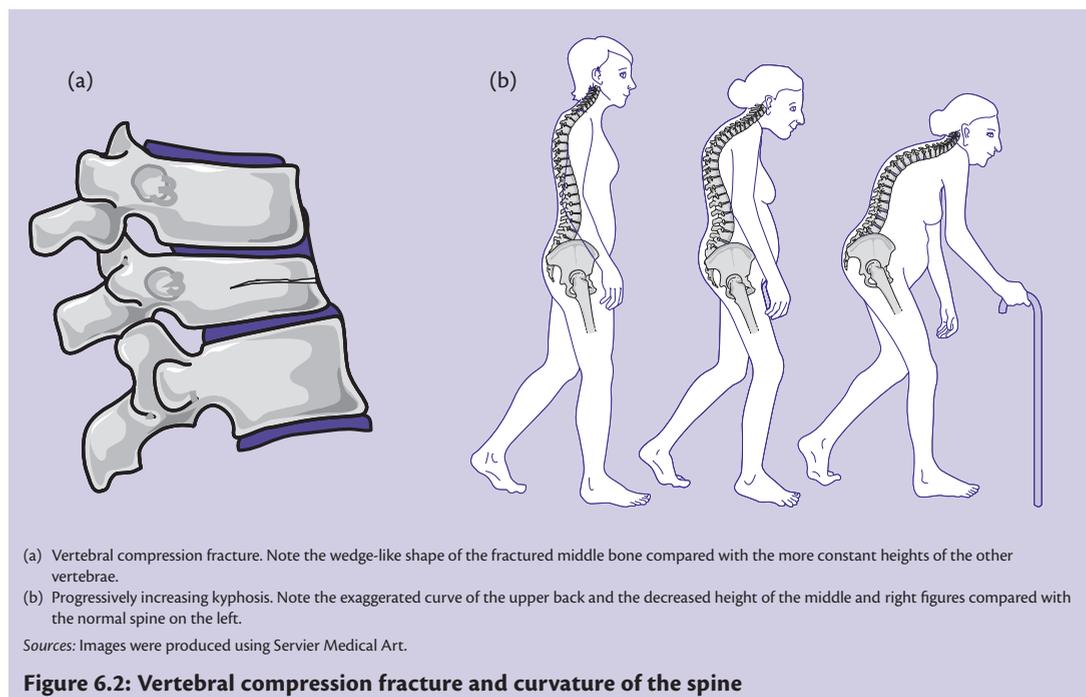
### Spine

The spine is made up of 24 individual bones, called vertebrae. These are stacked on top of one another and are separated by discs of tissue. The spine can be separated into three regions: the cervical spine (the neck), consisting of seven vertebrae; the thoracic spine (upper and middle back), made up of 12 vertebrae; and the lumbar spine (lower back), made up of five vertebrae. At the lower end of the lumbar spine are the sacrum and coccyx, or tail bone.

The most common type of spinal fracture (also known as a 'vertebral fracture') in people with osteoporosis is called a wedge or compression fracture. These generally occur in the thoracic region of the spine (particularly at the lower end) or the upper end of the lumbar region. In this type of fracture, one or more of the vertebrae collapses, most commonly at the front, forming a wedge shape

(Figure 6.2(a)). This can cause curvature of the spine, and people who have had a number of spinal compression fractures may display a characteristic bent-forward, hunched posture known as kyphosis (sometimes called a 'widow's or dowager's hump'), and have a noticeable loss of height (Figure 6.2(b) and (c)). Kyphosis can also result from degenerative spinal disease.

In people with severe osteoporosis, a spinal fracture may be caused by simple movements such as lifting a light object, sneezing, or even just bending forward. In people with less severe osteoporosis, more force may be required, for example, a fall or lifting a heavy object. In many cases, compression fractures may cause no pain, or minor, indistinct pain, which may be mistaken for arthritis or muscular symptoms, meaning they often remain undiscovered.



## Ankle

Fractures to the ankle usually involve a break at the bottom of one or both of the two lower leg bones (tibia and fibula). The lower ends of these bones wrap around the sides of the ankle bone (talus); these are the bony lumps (called the malleoli) that can be felt on either side of the ankles.

Ankle fractures can occur when the ankle rolls in or out, putting stress on the joint. In many cases, rolling of the ankle will injure only the surrounding muscles or ligaments; this is a sprain or 'twisted ankle'. But in some cases the end of the tibia or fibula will be broken. Fractures of the bones under the ankle joint may also occur, but are less common.

Although ankle fractures are relatively common in older people, they are not generally related to osteoporosis (Greenfield & Eastell 2001; Hasselman et al. 2003; Seeley et al. 1996). Rather, fractures of the ankle are more common in people with a history of falls and in those who are overweight (Hasselman et al. 2003; Seeley et al. 1996).

## Shoulder

The shoulder consists of three bones: the upper arm bone (humerus), the shoulder blade (scapula) and the collarbone (clavicle). Like the hip, the shoulder joint is a ball-and-socket joint, with the upper arm bone ending in a ball that fits into a shallow socket in the shoulder blade. The socket is surrounded by a fibrous ring of cartilage that helps to hold the arm bone in place and stabilise the joint, assisted by the surrounding muscles.

Fractures to the shoulder normally involve either the collarbone or the neck of the humerus (the region just below the ball). Falls are the most common cause of fractures at either of these sites.

Fractures of the upper humerus are commonly associated with osteoporosis.

### Box 6.2: Bone development and loss

The likelihood that a person will develop osteoporosis is related to the way their bones develop and are maintained over the life span. Throughout life, minerals such as calcium and phosphorous are constantly deposited and absorbed from the bones. This is a normal part of healthy bone growth and maintenance. At different periods throughout life, the rates of deposition and absorption change. Deposition levels are at their highest during childhood and adolescence, when large amounts of bone are formed during 'growth spurts'. By the age of around 20–30 years, bone mass has reached its peak. Factors affecting peak bone mass include diet, calcium intake, exercise levels and genetics.

For around the next 20 years of life, bone is absorbed at about the same rate as it is deposited, maintaining the skeletal structure. After the age of about 40–50 years, the rate of absorption increases and bone mass is lost. Various factors, including diet, calcium intake, activity levels and hormonal changes, can influence the rate of loss.

Figure 6.3 shows the effects of different patterns of bone growth and loss on the development of osteoporosis. Person 1 represents a person without osteoporosis; he achieves a good peak bone mass and has a modest rate of bone loss with age. Person 2 reaches 'normal' peak bone mass, but has a relatively high rate of bone loss and eventually develops osteoporosis. Person 3 has a 'normal' rate of bone loss, but reaches the osteoporotic level due to her relatively low peak bone mass.

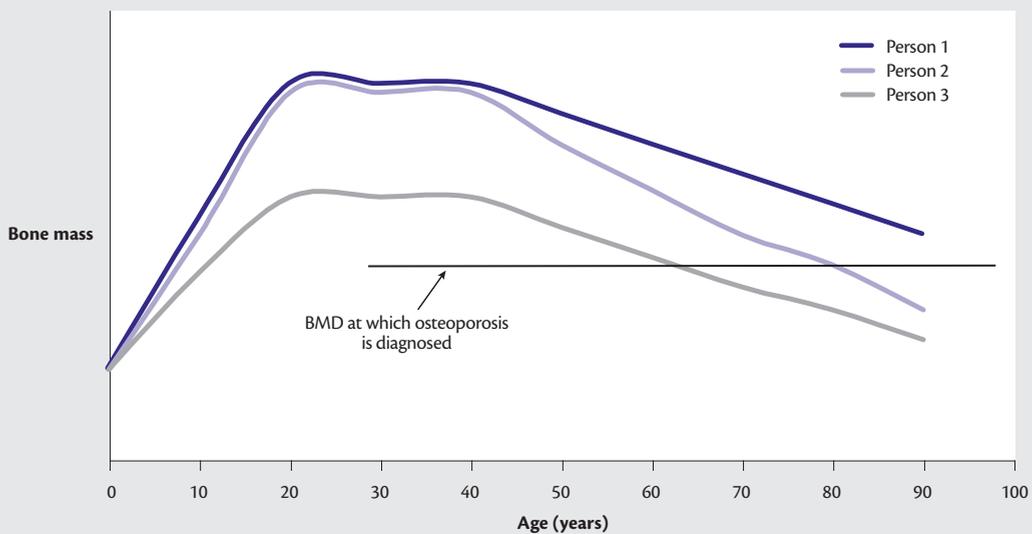


Figure 6.3: Patterns of bone growth and loss through life

## RISK FACTORS FOR OSTEOPOROSIS AND FRACTURES

A number of modifiable and non-modifiable factors increase the risk of osteoporosis and osteoporotic fractures (Table 6.1). These include older age, being physically inactive, having a family history of osteoporosis or minimal trauma fractures, poor calcium intake, vitamin D deficiency and (in women) being post-menopausal. Where possible, reducing exposure to these factors can help to prevent osteoporosis. Some prevention strategies are discussed later in this chapter.

Since minimal trauma fractures are an outcome of having low bone mineral density (BMD), the factors that increase the risk of having low BMD also increase the risk of a fracture. However, low BMD is not the only contributor to fracture risk. In fact, a person can experience a minimal trauma fracture without having BMD in the osteoporotic range. Factors that can increase the risk of fracture independently of BMD include a history of falls and high propensity to fall. These and other risk factors are described briefly below.

**Table 6.1: Risk factors for osteoporosis and fracture**

Biomedical and genetic factors	Behavioural factors	Other factors
Female sex, particularly after menopause	Smoking	Systemic illnesses (e.g. rheumatoid arthritis)
Excessively low body weight	Physical inactivity	Metabolic disorders
Older age	Poor calcium intake	Long-term corticosteroid use
Action of genes associated with skeletal maintenance	Lack of sunlight exposure	Physical disabilities that restrict weight-bearing exercise
White or Asian heritage		History of falls
Previous minimal trauma fractures		Propensity to fall
Family history of osteoporosis or fractures		Disorders involving malabsorption (e.g. coeliac disease)

### Biomedical and genetic factors

- Women are at greater risk of osteoporosis than men, particularly once they have reached menopause. Total bone mass in females is naturally lower than in males, and the normal decrease in bone mass with age is accelerated in post-menopausal women due to their decreased oestrogen levels.
- Weight is related to bone mineral density, as having a higher body mass means that more weight is borne by the bones, which then strengthen in response to this stress. People who are significantly underweight tend to have lower bone mineral density, which may lead to increased risk of osteoporosis and fractures. Weight loss is also associated with increased bone loss.
- People with a family history of osteoporosis or minimal trauma fracture are also at increased risk. Daughters of women with osteoporosis of the spine tend to have decreased bone mass. A maternal history of hip fracture doubles the risk of hip fracture in women and increases the risk of spinal deformities in men (Cummins et al. 1995; Diaz et al. 1997).
- People from certain population groups may be more likely to develop osteoporosis. White and Asian populations tend to have a lower average bone mass than black or Hispanic groups (Cumming et al. 1997).

- Several genes have been found to be associated with skeletal maintenance, and genetic variation has been found to account for a large proportion of the variation in bone mineral density (Nuki et al. 1999). However, it is difficult to identify relevant genetic pathways due to the large number of genes interacting with each other and with environmental factors.
- People who have had a minimal trauma fracture are at increased risk of subsequent fractures, an effect known as the 'fracture cascade'. Data from the Dubbo Osteoporosis Epidemiology Study show that the increase in risk persists for up to 10 years, and that 40% of women and 60% of men will experience a second fracture within this period (Center et al. 2007). Although almost all fracture types are associated with an increased risk of further fractures, men aged 60–69 years with hip or vertebral fractures are at greatest risk.

### Behavioural factors

- Smokers tend to have a lower bone mass than non-smokers. It is believed that smoking lowers body weight, interferes with the hormones that affect bone strength and may have a detrimental effect directly on the bones (Wong et al. 2007).
- Exercise is important in building and maintaining bone mass. Low physical activity levels during childhood and adolescence result in lower peak bone mass, so bone loss later in life more quickly reaches the level of osteoporosis.
- Calcium is essential for bone formation. The body cannot make calcium so it must be obtained from the diet. Low calcium intake is associated with low bone mineral density.
- Vitamin D helps the body to absorb calcium and is needed to regulate bone formation. Although small amounts of vitamin D may be obtained from the diet, the majority is synthesised by the body via exposure of the skin to sunlight. People who are institutionalised or housebound, or those who wear clothing that covers most of the body, may be particularly at risk of having low vitamin D levels.

### Other factors

- Some systemic illnesses affect bone metabolism and increase the risk of osteoporosis. These include rheumatoid arthritis, chronic kidney disease, metastatic cancer and thyrotoxicosis (a condition resulting from excessive amounts of thyroid hormones).
- The metabolic disorders hypogonadism (abnormally decreased activity of the ovaries or testes, which retards growth and sexual development) and hyperparathyroidism (over-production of parathyroid hormone, which leads to increased absorption of calcium from the bones) are associated with decreased bone mass.
- In a similar manner to people who are underweight, people with physical disabilities may be at increased risk of osteoporosis if they are unable to perform weight-bearing exercise to build and maintain bone mass. This may be particularly the case for those who are affected by disability in the peak bone formation periods of childhood and adolescence. People who have disabilities affecting their mobility may also be more likely to fall, putting them at increased risk of fractures.
- Long-term use of corticosteroid medications increases the risk of fractures. Conditions that may require long-term corticosteroid treatment include asthma and rheumatoid arthritis.

- Malabsorption reduces calcium absorption and vitamin D levels, increasing the risk of osteoporosis. Causes of malabsorption include coeliac disease and inflammatory bowel disease.
- People who have a propensity or predisposition to falling are also more likely to experience fractures. There are many reasons why a person may be more likely to fall, including problems with balance, use of medications causing dizziness and problems with mobility.
- A history of falls is associated with increased risk of fractures, regardless of BMD. Data from the Dubbo Osteoporosis Epidemiology Study showed that among men and women whose BMD was not in the osteoporotic range, those who had had a fall in the previous 12 months were twice as likely to experience a fracture as those who had not fallen (Nguyen et al. 2007). The study also found that women who fell were at high risk of subsequent falls, and that each fall further increased the risk of a fracture (Nguyen et al. 2001).

### Markers of increased risk

A number of other factors, which are not in themselves direct risk factors, can act as markers to indicate people with an increased risk of fracture. These include loss of height, poor quadriceps strength and body sway. Although not direct risk factors, these three indicators are easily measured in clinical practice and are highly correlated with fracture risk.

Loss of height may indicate that a person has suffered several vertebral compression fractures. As these fractures may cause no pain, or only moderate, non-specific pain that may be mistaken for a muscular strain, disc problem or arthritis, the loss of height and stooping posture caused by compression of the spine may be the only recognisable sign that fractures have occurred. People who have experienced vertebral fractures are at high risk of further fractures (Center et al. 2007).

Poor quadriceps strength is a risk factor for falls, but not for fractures. Data from the Dubbo Osteoporosis Epidemiology Study show associations between lower quadriceps strength, falls in the previous 12 months, and recent fall-related fractures (Lord et al. 1994). The association between poor quadriceps strength and fractures is mediated by an increased risk of falling (Nguyen et al. 2007).

'Body sway' describes the extent to which a person sways (in any direction) while standing still on a flat surface. Significant body sway may indicate physical instability, muscle weakness, side-effects of medication or problems with balance. All of these can increase a person's risk of falling and hence of experiencing a fracture.

## IMPACTS OF OSTEOPOROTIC FRACTURES

Since osteoporosis has no symptoms, its impacts are mainly seen in terms of the fractures and the effects these have on functioning and quality of life. Apart from the pain and loss of function associated with the fracture event itself, there can also be more long-term impacts on physical and mental health and functioning. These may include not only ongoing pain, physical impairments and disability, but also reduced social interaction, emotional distress, and self-limitation caused by the fear of falling and fracturing a bone. In a small proportion of cases the fracture and its after-effects may lead to death.

## Pain

In most cases, the pain associated with breaking a bone is the patient's most immediate concern. The amount of pain felt varies widely between individuals and depends on the site and severity of the fracture.

In the case of spinal fracture, the event may be nearly or completely painless, and the fracture may go undetected (Haczynski & Jakimiuk 2001). It has been suggested that up to two-thirds of spinal fractures may not receive medical attention (Cooper et al. 1992). The sudden onset of low back pain in a person with osteoporosis may be a sign of spinal fracture.

People who have experienced fractures may have ongoing or chronic pain well after the bone has healed. This pain can result from the changes in posture and strain on muscles, ligaments and joints that occurs to compensate for the injury. Untreated or persistent pain may lead to sleeplessness and depression, and reduce the quality of life (Lukert 1994; Oglesby et al. 2003; Silverman et al. 2001).

## Functional limitations and disability

Different types of fractures are associated with varying degrees and types of functional limitation. For example, fractures involving the shoulder, arm, wrist or hand may affect the ability to write, prepare meals, manage household chores and perform personal-care activities (such as dressing or brushing teeth and hair). Fractures involving the spine, hips, legs or feet affect mobility as well as the ability to perform personal and household tasks. Spinal fractures may also interfere with actions such as bending, reaching, lifting, and pulling or pushing, particularly if several fractures have occurred.

Data from the 2003 Survey of Disability, Ageing and Carers suggest that around 50,000 Australians aged 35 years or over have a disability caused mainly by osteoporosis (AIHW: Rahman & Bhatia 2007). Almost half of these people have severe or profound core activity limitations—that is, they require assistance with one or more activities of daily living (such as self-care or mobility). Various assistive devices (for example, walking frames, grab bars, special tooth brushes and long-handled reachers) are available to enable people with functional limitations to perform their daily activities. More than half of people aged 35 years or over who have osteoporosis as their main disabling condition report using such devices (AIHW: Rahman & Bhatia 2007). Additional assistance from family, friends, community volunteers or paid care workers may also be required.

Hip fracture is among the top 10 causes of burden of disease among women in developed countries, estimated to account for 1.4% of disability-adjusted life years (Johnell & Kanis 2004). Cooper (1997) reported that one year after hip fracture, 30% of women were unable to walk independently, 60% had difficulty with at least one activity of daily living, and 80% were limited in activities such as driving and shopping. Long-term functional limitations are also common: Willig and colleagues found that people who had had a hip fracture were significantly less likely than age- and sex-matched controls to be able to perform basic activities of daily living (such as using the bath or toilet, dressing, cooking and doing housework) seven years after the event (Willig et al. 2001).

## Social isolation

The immediate effects of a fracture on mobility and performing usual activities can also affect a person's social life. For example, they may be temporarily unable to participate in games, sports or hobbies, or find it difficult to travel to meeting places, clubs or friends' homes. In the longer term, any ongoing functional limitations or disability can extend these immediate effects on social participation for months or years. At a seven-year follow-up of people with trochanteric hip fracture, 74% reported they were unable to visit friends (Willig et al. 2001). This can reduce the quality of life and lead to feelings of frustration, loneliness and depression. In the 2003 Survey of Disability, Ageing and Carers, around one-third of people aged 35 years or over who had osteoporosis as their main disabling condition reported that they could not go out as often as they would like due to their condition (AIHW: Rahman & Bhatia 2007).

People who have had a fracture may be anxious about or afraid of the potential consequences of further fractures, such as loss of independence and the possibility of needing permanent care. Those who have had a fracture due to falling may also be fearful of having another fall (Salkeld et al. 2000). People who have such fears may limit their participation in social activities in an effort to reduce their risk (Fletcher & Hirdes 2004; Gold 2001).

## Quality of life and mental health

The physical effects of a fracture can have a substantial impact on a person's quality of life and mental wellbeing. The pain, functional limitations and need for assistance with daily activities can lead to feelings of anger, sadness, hopelessness and helplessness, reduced self-confidence and self-esteem, embarrassment and loss of dignity (Haczynski & Jakimiuk 2001; Sitoh et al. 2005). In addition, the person may experience fear and anxiety about their future and the risk of further fractures (Salkeld et al. 2000).

Although quality of life is generally reduced in the period immediately following a fracture, regardless of the type of fracture sustained, in the long term people with more severe fractures or fractures in sites resulting in greater limitations continue to experience poorer quality of life compared with people with less severe fractures or without fractures (Hallberg et al. 2004). Two years after fracture, people with forearm or upper arm fractures report similar health-related quality of life to the general population, but people with hip and spinal fractures report poorer quality of life across a range of domains including physical functioning, bodily pain and social functioning (Hallberg et al. 2004).

## Loss of independence

The limitations in activity and possible long-term disability resulting from a fracture can seriously affect a person's independence. Depending on the site and severity of the injury, the person may need assistance with household tasks (such as cleaning and cooking), transport, mobility, or personal-care tasks (such as bathing, toileting and dressing). In some cases (for example, if the effects of the injury are long-term or if the person has no-one to assist them until they recover) the person may need to temporarily or permanently move from their own home into a rehabilitation unit, nursing home or aged care facility. People who move to a nursing home following a fracture tend to be older and in poorer pre-fracture health than those who remain in their own homes (Osnes et al. 2004).

In 7% of hospitalisations for minimal trauma fracture among Australians aged 40 years or over in 2006–07, the patient was discharged to an aged care facility where this had not previously been their usual residence. This was most common for fractures of the hip and pelvis: patients previously resident in the community were discharged to an aged care facility in 10% of cases. People who have had a hip fracture are significantly less likely to be living in their own home seven years later than people of the same age without hip fracture (Willig et al. 2001).

The need for assistance with daily activities and the need to move from their own home may greatly affect the person's self-esteem, social contact and emotional wellbeing.

## Mortality

Fractures are recorded as an associated cause of around 2,500 deaths in Australia each year. (Coding standards specify that injuries should not be reported as the underlying cause of death.) More than 80% of these are deaths in people aged 75 years or over. High trauma events (such as motor vehicle accidents) account for around 10% of cases; of the remainder, about 25% are accidents caused by low-trauma events, 20% are accidents caused by 'exposure to an unspecified factor', and the rest are attributed to various diseases and conditions and other external causes. The fracture sites most commonly reported on death certificates are the hip and pelvis, accounting for around 70% of cases.

Almost all types of minimal trauma fractures are associated with increased mortality over the following 12 months (Center et al. 1999; Johnell et al. 2004; NAMSCAG 2004). However, fractures of the hip and pelvis are the most commonly associated with an increased risk of death. The majority of deaths occur within the first few months, although the mortality rate in people who have had a hip fracture is still higher than expected up to 5 years after the event (Empana et al. 2004). In 2006–07, 1,163 separations for minimal trauma hip or pelvic fracture (6%) resulted in death in hospital.

In 2006, a hip or pelvic fracture was recorded as an associated cause of 1,516 deaths in Australia. Almost all of these deaths occurred in persons aged 65 years or over, with 63% (949 deaths) among people aged 85 years or over. In cases where hip or pelvic fracture was an associated cause of death, the most commonly recorded underlying causes of death were falls (accounting for 24% of deaths) and diseases of the circulatory system (23%). 'Exposure to an unspecified factor' was recorded as the underlying cause of death in 18% of cases (267 deaths), and osteoporosis was recorded as the underlying cause of 4 deaths. Analysis by the National Injury Statistics Unit suggests that the majority of deaths from 'exposure to an unspecified factor' where a fracture was also recorded would have involved falls (AIHW: Kreisfeld & Harrison 2005).

It has been suggested that the contribution of injuries to deaths may be underestimated due to the tendency to record 'natural' causes (for example, cardiovascular disease) in preference to external causes as the underlying cause of death for elderly persons (AIHW: Kreisfeld & Newson 2006; Calder et al. 1996; Roberts & Benbow 1996). The extent to which this might affect estimates of mortality due to osteoporosis and minimal trauma fractures is unknown.

## PREVENTION OF OSTEOPOROSIS AND FRACTURES

Avoiding or (where possible) altering exposure to risk factors forms the basis of many prevention strategies. For osteoporosis this includes getting enough calcium and vitamin D, keeping physically active, maintaining a healthy weight and not smoking. Preventing falls is also an important component of fracture prevention strategies, particularly among people who have a low bone mineral density or who are frail. In addition, there is some evidence that protecting the bones during a fall or other impact may help to prevent fractures.

### Preventing osteoporosis

A good diet is essential for good health. Adequate intake of foods containing calcium (such as dairy products, green leafy vegetables and fish with edible bones) is important for bone formation. Children, adolescents, pregnant or breastfeeding women, postmenopausal women, and men aged 70 years or over require higher than average amounts of calcium to build bone mass and offset bone and calcium losses (NHMRC 2003).

A balanced diet will also help to maintain a healthy weight. Excessively low body weight or weight loss may result in low bone mineral density and increased risk of osteoporosis and fractures. People who are overweight tend to have a lower risk of fracture due to their higher bone density, and also because the additional soft tissue provides protection for the bones during a fall or other low-trauma impact. However, since being overweight or obese may increase the risk of other conditions, such as osteoarthritis, Type 2 diabetes and heart disease, it is important to maintain a healthy weight throughout life.

Vitamin D is necessary for the absorption of calcium. Although there are some dietary sources of vitamin D (for example, oily fish, liver and eggs), the majority of Australians obtain most to all of their vitamin D through exposure to sunlight (Nowson & Margerison 2002). In people with moderately fair skin, exposure of the hands, face and arms for up to 10 minutes per day during summer and up to 45 minutes per day during winter (depending on latitude) is recommended for adequate vitamin D synthesis (Working Group of the Australian and New Zealand Bone and Mineral Society et al. 2005). However, it is important to avoid excessive sun exposure, and limit exposure to the early morning or late afternoon periods, to reduce the risk of skin cancer.

Exercise in childhood and adolescence is also vital for building strong bones and achieving a high peak bone mass. Continuing to exercise throughout life can help to maintain bone mass by slowing the normal loss experienced with age. Although all types of exercise are valuable for improving general health, muscle strength and cardiovascular fitness, high-impact weight-bearing exercise (such as brisk walking, running, skipping and aerobics) is particularly beneficial for bone health.

Hormone replacement therapy (HRT) can increase bone mineral density and decrease the risk of fractures in postmenopausal women (Cauley et al. 2003). However, the long-term use of HRT for the prevention of osteoporosis is not recommended in Australia, due to the risks of HRT in relation to breast cancer and cardiovascular disease (NHMRC 2005).

Raising awareness about osteoporosis and its effects, and educating people about how they can reduce their risk, are also important components of population-wide prevention strategies.

## Fall prevention

A wide range of factors may influence an individual's risk of falling (Box 6.3). Environmental hazards (for example, uneven or slippery surfaces, loose rugs and poor lighting) may be thought of as the most obvious causes of falls, but individual factors play a significant role. Older people are more prone to falls because of the general deterioration in bodily function associated with ageing. This may include muscular weakness, poor circulation (which may cause temporary dizziness when getting up out of a chair or bed) and changes in cognitive function. People with certain chronic illnesses, congenital conditions or disabilities that affect muscular strength, balance, consciousness or mobility are also at higher risk of falling. Other factors that increase risk include problems with eyesight, use of sleeping pills, and side-effects of some medications (for example, dizziness and drowsiness).

As with osteoporosis prevention, the focus of most fall prevention activities is to target modifiable risk factors. These include changing or adapting behaviours to limit the risk posed by individual factors, and removing or limiting exposure to environmental hazards (for example, by installing grab rails and non-slip floor strips). Regular physical activity is important as this can help to strengthen the muscles and improve balance and mobility. In particular, Tai Chi has been found to be effective in improving muscular strength and balance and reducing the incidence of falls (Choi et al. 2005; Li et al. 2004; Voukelatos et al. 2007). Appropriate management of medications is another key fall-prevention strategy. Some strategies for preventing falls in the home are outlined in Box 6.4.

### Box 6.3: Risk factors for falling

- *Chronic illness*
- *Balance, gait or mobility problems*
- *Visual impairment*
- *Cognitive impairment*
- *General deterioration associated with ageing*
- *History of falls*
- *Fear of falling*
- *Depression*
- *Blackouts/fits*
- *Indoor and outdoor hazards*
- *Use of medications or other drugs that cause dizziness or drowsiness*
- *Physical inactivity*
- *Foot problems.*

## Using hip protectors

If a person with osteoporosis does experience a fall or other impact, the use of hip protectors may help to prevent fractures of the hip or pelvis (Sinaki 2004). These protectors generally take the form of padded leggings or shorts, and are designed to absorb the impact that could otherwise have broken a bone. However, compliance with wearing hip protectors has been found to be variable; people may find them uncomfortable, difficult to put on and take off, and irritating to the skin, and may consider them to be unattractive (van Schoor et al. 2002). A recent systematic review has suggested that, although hip protectors may help to prevent hip fractures in people living in nursing or residential care settings, they may be ineffective for persons living in their own home because of poor compliance (Parker et al. 2006). Hip protectors are only effective if they are worn correctly.

**Box 6.4: Preventing falls in the home**

*A few relatively simple adjustments can decrease the risk of falls in the home and garden:*

- *stay active, and include some exercises to help with balance and posture*
- *attend a falls prevention class*
- *have medications reviewed by a doctor or chemist, as some may cause dizziness and increase the risk of falling*
- *remove or repair trip hazards in walkways (for example, loose rugs, electrical cords, unsecured carpet edges, and uneven paving or tiles)*
- *use bright lighting, have bedside lamps for use during the night, and install sensor lights in walkways*
- *install railings in the bathroom and toilet to assist with sitting, rising and general balance*
- *wear sensible, well-fitting shoes (avoid backless slippers, high heels and thongs), and ensure hems of skirts and trousers are above the floor*
- *install non-slip safety strips in the bath and shower, near the bathroom, kitchen and laundry sinks, and on uncarpeted or outdoor stairs*
- *avoid excessive alcohol intake*
- *use a walking aid if required*
- *have eyesight checked regularly.*

*Sources: Adapted from Osteoporosis Australia 2006 and National Osteoporosis Foundation 2006.*

## **TREATMENT AND MANAGEMENT OF OSTEOPOROSIS AND OSTEOPOROTIC FRACTURES**

Osteoporosis is generally managed with medication, including prescription drugs and vitamin and mineral supplements. The most commonly used medications are calcium supplements, calcium combined with vitamin D, and bisphosphonates. All of these medications act to reduce the rate of bone loss.

Two drugs that increase bone formation are currently available in Australia: parathyroid hormone and strontium ranelate. Parathyroid hormone is given as daily injections. Although continuously having excess amounts of this hormone in the blood (as in people with hyperparathyroidism) can actually cause osteoporosis, small amounts given intermittently as a daily injection stimulate the formation of new bone (Cranney et al. 2006). The precise mechanism by which this occurs is not yet fully understood. Parathyroid injections are not currently subsidised under the Pharmaceutical Benefits Scheme (PBS). Strontium ranelate is also taken daily, but in oral form. It both stimulates bone formation and reduces bone resorption. Strontium ranelate is subsidised under the PBS for treatment of osteoporosis in postmenopausal women with previous minimal trauma fractures and in women aged 70 years or over with a BMD T-score of  $-3.0$  or less.

Regular exercise in people with established osteoporosis can help to reduce further decreases in BMD, as well as assisting in maintaining a healthy weight. Exercise can also help to increase and maintain mobility and balance, which can reduce the risk of falling (a major cause of osteoporotic fractures).

Tai Chi has been found to be particularly effective in reducing falls and fractures among older people. A healthy diet, incorporating sufficient calcium and other nutrients, is also important for maintaining healthy weight and reducing further bone loss. As previously noted, a medications review may be beneficial to reduce the risk of medication side-effects leading to a fall. These reviews are subsidised through Medicare for eligible persons; more than 75,000 home medicines reviews were provided under Medicare during 2007–08 at a cost to the Australian Government of over \$8.5 million (Medicare Australia 2008).

A major component of management of people with osteoporosis is the prevention of falls, and the treatment of any fractures that occur. Fracture treatment includes appropriate follow-up, investigation of the causes of the fracture in people who have not previously been diagnosed with osteoporosis, and initiation of osteoporosis treatment if necessary. There are a number of places where treatment for a fracture may be received, including GP surgeries, clinics, and at hospitals, either in the emergency department or as an admitted patient. However, at all points in the continuum of patient care, the majority of osteoporotic fractures are both under-diagnosed and under-treated (NAMSCAG 2004).

## Management by general practitioners

General practitioners (GPs) are the first line of care for people with osteoporosis, advising on diet and exercise, treating minor fractures and prescribing appropriate medications. Osteoporosis was managed at a rate of 9 per 1,000 encounters reported to the BEACH (Bettering the Evaluation and Care of Health) GP survey in 2007–08. This equates to around 980,000 Medicare-paid GP consultations for osteoporosis between April 2007 and March 2008. One in five encounters were for 'new' cases of osteoporosis (that is, the person had not previously seen a medical practitioner for osteoporosis). The vast majority (99%) of encounters where osteoporosis was managed were for people aged 40 years or over; osteoporosis was managed at 15 per 1,000 encounters among people of this age.

The most common action taken by GPs to manage osteoporosis was to prescribe, advise or supply medication. Calcium supplements, vitamin D supplements, and the bisphosphonates alendronate and risedronate were the most frequent medications reported. Bone mineral density tests and X-rays of the chest/spine were ordered for 21% and 8% of new osteoporosis cases, respectively.

Fractures were managed at a rate of 6 per 1,000 encounters for persons aged 40 years or over reported to the BEACH GP survey in 2007–08, equating to more than 390,000 Medicare-paid GP consultations. Thirty-eight per cent of fractures managed were new fractures (that is, the first time the patient had seen a medical practitioner for that fracture).

Fractures of the spine or wrist/forearm were the most common fractures managed among persons aged 40 years or over in 2005–06, accounting for 22% and 15% of new fracture problems, respectively. At least one medication was prescribed, advised or supplied in 84% of encounters for new fractures, with analgesics (painkillers) being the most common drugs recorded. X-rays, CT scans or ultrasound scans of the fracture site were ordered in 47% of new cases, and bone mineral density testing was requested in 9% of new cases. Note that although an encounter may be for a new fracture, the person may have already been diagnosed with osteoporosis and so diagnostic tests such as bone mineral density scans may not be required.

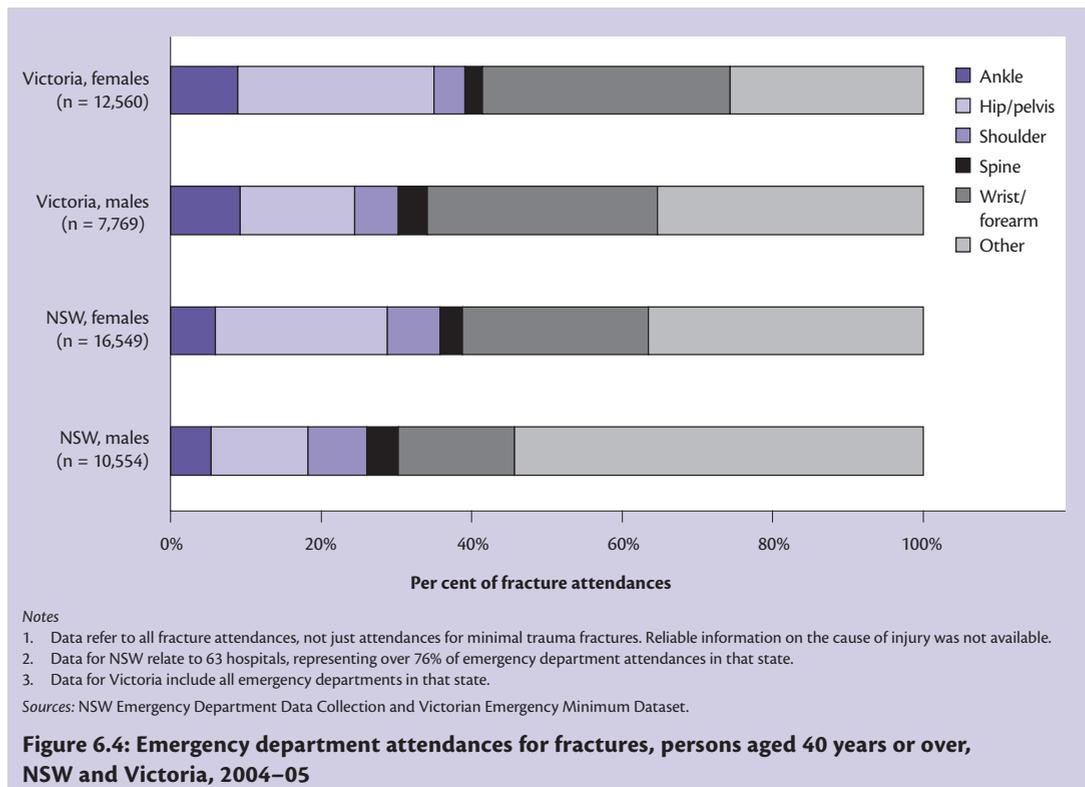
## Emergency department attendances for fractures

Data relating to services provided in hospital emergency departments are limited. The national administrative data collection (the Non-Admitted Patient Emergency Department Care Database, held at the AIHW) does not include any diagnostic information, and so national data on emergency department attendances for particular conditions or injuries are not able to be generated. However, some information on fractures is available at the state and territory level.

Over 27,000 fractures among people aged 40 years or over were reported to the New South Wales Emergency Department Data Collection in 2004–05, with 61% of these occurring in women (Figure 6.4). Reliable information on the cause of the fracture was not available. Fractures of the wrist and forearm were the most common, followed by fractures of the hip and pelvis.

Data from the Victorian Emergency Minimum Dataset show that 20,198 fractures in persons aged 40 years or over presented to Victorian emergency departments during 2004–05 (Figure 6.4). The proportion of these fractures that were the result of minimal trauma is unknown. Fractures were more common among females than males, with the most common fracture sites being the wrist and forearm.

Although these emergency department data do not specify whether fractures were the result of minimal trauma, it is likely that the majority of fractures in people aged 40 years or over would be related to osteoporosis.



Patients presenting to the emergency department may be formally admitted to the hospital for further treatment or care. In this case they will also be included in counts of admitted patient episodes, as presented in the next section. The decision to admit a person with a fracture to hospital depends on the type of treatment required, the severity of the injury and whether the patient would be able to care for him- or herself (or has somebody to care for them) at home. The numbers in Figure 6.4 include all cases presenting to emergency departments, regardless of whether or not they were later admitted to hospital.

## Hospital services for fractures

In 2006–07 there were 50,993 hospital separations for minimal trauma fractures in persons aged 40 years or over. (Cases where the patient was transferred between hospitals have been counted only once.) More than three-quarters of these separations (77%) involved fractures at one of the major sites described above (hip/pelvis, wrist/forearm, spine, ankle or shoulder), with hip and pelvic fractures accounting for 40% of minimal trauma fracture separations in this age group (Table 6.2). These data substantially underestimate the number of minimal trauma fractures occurring in Australia, as the majority will not be treated in hospital.

**Table 6.2: Hospital separations for minimal trauma fractures, persons aged 40 years or over, 2006–07**

Fracture region and site <sup>(a)</sup>	Males	Females	Persons	Per cent
Ankle	824	2,377	3,201	6
Hip and pelvis	5,294	15,209	20,503	40
– Femoral neck fracture	2,362	6,400	8,762	17
– Intertrochanteric fracture	1,337	3,659	4,996	10
– Pelvic fracture	751	3,185	3,936	8
– Other	844	1,965	2,809	6
Shoulder	990	3,154	4,145 <sup>(b)</sup>	8
– Fracture of clavicle	197	258	456 <sup>(b)</sup>	1
– Fracture of neck of humerus	722	2,782	3,504	7
– Other	71	114	185	—
Spine	863	1,915	2,778	5
Wrist and forearm	1,381	7,442	8,823	17
– Colles fracture	428	3,786	4,214	8
– Scaphoid fracture	56	52	108	—
– Other	897	3,604	4,501	9
Other or multiple sites	4,154	7,389	11,543	23
<b>Total</b>	<b>13,506</b>	<b>37,486</b>	<b>50,993<sup>(b)</sup></b>	<b>100</b>

— Less than 1%

(a) Based on principal diagnosis.

(b) Includes one case where the sex of the patient was not recorded.

### Notes

1. A separation for minimal trauma fracture was defined as any separation of a person aged 40 years or over with the principal diagnosis of a fracture and an external cause code indicating minor trauma (see Appendix 2 Table A2.1 for codes used).
2. Separations where the patient was transferred from another hospital were excluded (7,298 cases, or approximately 13% of all minimal trauma fracture separations). This provides a more accurate estimate of the number of fractures that required hospital treatment as an admitted patient.

Source: AIHW National Hospital Morbidity Database.

Interventions provided during separations for minimal trauma fractures range from simple immobilisation of the fracture area or limb to surgical realignment and fixation of the fractured bone. In some cases involving fracture at a joint, total or partial replacement of the joint is undertaken. People with hip fractures are the most likely to undergo joint replacement; over 4,700 partial hip replacements for minimal trauma hip fractures were undertaken in 2006–07.

Allied health interventions are very common in people with minimal trauma fractures, particularly where the fractures involve the spine, hip, pelvis or lower limbs. These interventions can help people to regain movement, improve mobility, adapt to any functional limitations caused by their injury, and reduce their risk of further fractures and falls. The most common types of allied health intervention provided are physiotherapy (provided in 65% of separations for minimal trauma fractures in 2006–07), occupational therapy (32%), social work (19%) and dietetics (12%) (Table 6.3).

**Table 6.3: Interventions provided in separations for minimal trauma fractures, persons aged 40 years or over, 2006–07**

Intervention	Number <sup>(a)</sup>	Per cent (n=58,291)
Immobilisation or non-surgical fixation	632	1.1
Reduction <sup>(b)</sup> with or without fixation	25,937	44.5
Arthroplasty (joint replacement)	6,295	10.8
– Partial arthroplasty of hip	4,777	8.2
Allied health interventions	40,120	68.8
– Physiotherapy	37,835	64.9
– Occupational therapy	18,527	31.8
– Social work	11,021	18.9
– Dietetics	6,955	11.9

(a) Refers to the number of separations in which the intervention was provided. Interventions may have been provided more than once within a separation, and multiple interventions may have been provided. See Appendix 2 Table A2.2 for codes used.

(b) Adjusting the alignment of the broken ends of the bone, to help it heal correctly. This can be done surgically or non-surgically. The ends of the bone can then be held in place ('fixed') non-surgically with a cast or splint, or surgically by inserting pins, plates, screws or rods through or along the bone.

*Notes*

1. A separation for minimal trauma fracture was defined as any separation of a person aged 40 years or over with the principal diagnosis of a fracture and an external cause code indicating minor trauma (see Appendix 2 Table A2.1 for codes used).
2. Separations where the patient was transferred from another hospital have been included in order to capture all treatment provided.

Source: AIHW National Hospital Morbidity Database.

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