INQUIRY QUESTION
What are the best methods for an individual to prevent injuries from occurring?
An inherent risk of participation in physical activity is injury to muscles and bones. There are a number of ways that an athlete can minimise this risk. Being physically fit, training appropriately for the activity and wearing protective gear can all act to reduce the incidence of common injuries.

**KEY KNOWLEDGE**
- Causes of potential acute and chronic injuries and illness associated with the muscular and skeletal systems such as arthritis, osteoporosis and other musculoskeletal conditions
- Physiological strategies to prevent musculoskeletal injuries such as physical preparation of athletes, warm ups and cool downs
- The role of physical aids that support the musculoskeletal system such as protective equipment, taping and braces

**KEY SKILLS**
- Examine a variety of causes of musculoskeletal injuries
- Describe and implement the correct application of techniques and physiological strategies in a variety of sporting activities to maintain optimal functioning of the musculoskeletal system

**CHAPTER PREVIEW**

- **Musculoskeletal system**
  - Types and causes of musculoskeletal illness and conditions
  - Types and causes of musculoskeletal injury
  - Prevention of injuries
- **Types and causes of musculoskeletal injury**
  - Osteoporosis
  - Back pain
  - Arthritis
  - Acute, chronic, overuse injuries
  - Physical aids
    - protective equipment
    - taping
    - braces
  - Physiological strategies
    - athlete preparation
    - warm up
    - cool down
4.1 Classification and types of sports injuries

**KEY CONCEPT** Injuries can be classified as acute, chronic or overuse. The type of injury sustained varies according to the cause of the injury. Injuries can affect hard or soft tissue in the body.

A musculoskeletal injury is any damage that occurs to the structures of the muscular or skeletal systems of the body.

**Acute injury** is an injury that occurs quickly and for which pain and loss of function is immediate.

**Direct injury** is caused by external force.

**Indirect injury** is caused by internal force.

Australians are encouraged to be physically active for good health. Current guidelines recommend that Australians be active on most, if not all, days of the week (see ch 11).

People who lead sedentary lifestyles and do not engage in sufficient physical activity are at a greater risk of ill health and possible death from a range of chronic illnesses and diseases. According to the Australian Institute of Health and Welfare (AIHW), physical inactivity contributes to 13 500 deaths each year in Australia. But as people engage more in physical activity, sport and exercise, there is greater potential for them to develop a musculoskeletal injury.

Injuries of the musculoskeletal system are a common occurrence during physical activity. Sports injuries can occur via accidents, poor training practices, improper equipment, clothing and footwear, as well as not being in the proper condition to participate in the selected physical activity. Once an injury is sustained, it impacts on the ability of the individual to effectively participate in sport or physical activity and can lead to further damage if not treated properly.

All areas of the body are at risk of suffering an acute injury. Injuries are largely preventable and a variety of measures can be taken to reduce this risk; these are discussed in sections 4.3 and 4.4. If not treated correctly, such injuries may become chronic or progress to a form of overuse injury.

**Classification of injuries**

Injuries can be classified into three types: acute, chronic and overuse.

An **acute injury** is one that occurs quickly and for which pain and loss of function is immediate. Acute injuries are classified according to how the injury occurred; either via a direct (external force) or indirect (internal force) mechanism.

**FIGURE 4.1** Examples of direct and indirect injuries
Acute injuries can be further classified by the structure that is injured (e.g. bone, ligament, muscle, joint) and the nature of the injury (e.g. fracture, sprain, strain). For example, a netballer who changes direction suddenly may sprain their ankle.

**TABLE 4.1** Types of acute injuries

<table>
<thead>
<tr>
<th>Type of acute injury</th>
<th>Caused by</th>
<th>Possible mechanism</th>
<th>Likely injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td>External force</td>
<td>Collisions between players</td>
<td>Bruise</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Direct contact with equipment</td>
<td>Cork</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fracture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cut</td>
</tr>
<tr>
<td>Indirect</td>
<td>Internal force</td>
<td>Overstretching connective tissue</td>
<td>Sprain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Losing balance</td>
<td>Strain</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tear</td>
</tr>
</tbody>
</table>

Specific examples of these injuries are presented in tables 4.2 and 4.3.

**Chronic injuries** tend to start out as acute in nature, and then recur as a result of re-injury through a prolonged weakness or insufficient rehabilitation following the previous injury. Recurring hamstring strains in AFL players are chronic injuries.

**Overuse injuries** are caused by excessive and repeated use of the same muscle, bone or joint, and are usually diagnosed by the presence of inflammation and pain. These injuries tend to be prolonged, taking a long time to recover (such as shin splints and stress fractures). Around 80 per cent of all overuse injuries occur in the lower body. Overuse injuries may occur via:

- Internal causes, e.g. muscle imbalance, anatomical problems such as poor posture
- External causes, e.g. training errors, incorrect technique, or uneven surfaces or hard running tracks.

(Overuse injuries are discussed further on page 63.)

**Acute injuries: soft and hard tissue**

Soft tissue injuries are the most common in sports and include any damage to skin, muscles, tendons and ligaments.

- A tear occurs when connective tissue — such as muscles, tendons and ligaments — is excessively stretched or ruptured. A tear can be either a:
  - strain: muscle or tendon, e.g. strained hamstring
  - sprain: ligament, e.g. sprained ankle.

These injuries occur when the connective tissue fibres cannot cope with the stress being placed on them (e.g. when a muscle contracts too quickly during the sudden acceleration in a sprint take-off) or when a joint is overextended (e.g. during a side push on the knee during a football tackle). Strains and sprains are classified by the number of fibres torn and thus the severity of the injury (figure 4.3).

**FIGURE 4.2** Ankle sprain
4.1 Classification and types of sports injuries

A contusion (or bruise) is caused by bleeding into the soft tissue. This generally results from a direct blow to the site via a collision with a player or piece of equipment (e.g. being hit by a cricket ball) or from a heavy fall.

**TABLE 4.2 Types of soft tissue injuries**

<table>
<thead>
<tr>
<th>Type of injury</th>
<th>Structure injured</th>
<th>Possible cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprain</td>
<td>Ligament</td>
<td>Excessive movement forcing the joint past its maximum range of motion, or external violence such as a side push on the knee during a football tackle</td>
</tr>
<tr>
<td>Strain</td>
<td>Muscle or tendon</td>
<td>Overstretching of muscle or tendon generally during sudden acceleration or deceleration</td>
</tr>
<tr>
<td>Contusion (bruise or haematoma) or a cork</td>
<td>Muscle, tendon, skin</td>
<td>Direct blow from a collision with a player or piece of equipment, or from a heavy fall</td>
</tr>
<tr>
<td>Open wound — cut, abrasion, laceration</td>
<td>Skin</td>
<td>Direct blow from a collision with a player or piece of equipment</td>
</tr>
</tbody>
</table>

Hard tissue injuries involve the bones of the skeleton. The most common injury to bones is a fracture.

A fracture is a break to the bone and it can be closed or open (compound), where the bone has broken through the skin (figure 4.4). A fracture can be caused by direct trauma to the area such as a blow, or an indirect trauma such as falling on an outstretched hand. Signs and symptoms of a fracture can include pain, swelling, bruising, tenderness, difficulty in moving or deformity.

Dislocations occur at a joint and involve the bones forming the joint being displaced. They damage both the hard tissue of bone and the surrounding connective tissue. Dislocations generally result from excessive movement of a joint; for example, falling awkwardly in the landing of a gymnastics routine. Signs
and symptoms include pain, swelling, tenderness, deformity or loss of movement. A partial dislocation is known as a subluxation.

Table 4.2 and 4.3 summarise the types of sporting injuries that may occur to different body structures and their possible causes.

### TABLE 4.3 Types of hard tissue injuries

<table>
<thead>
<tr>
<th>Type of injury</th>
<th>Structure injured</th>
<th>Possible cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture</td>
<td>Bone</td>
<td>Direct trauma such as a blow; indirect trauma such as falling on an outstretched hand</td>
</tr>
<tr>
<td>Dislocation/ subluxation</td>
<td>Joint</td>
<td>Excessive movement of the joint</td>
</tr>
</tbody>
</table>

### Overuse injuries

Athletes can develop an overuse injury during periods of high workloads and low levels of rest. This is particularly relevant to younger athletes who are going through puberty and growth spurts. A strategy for reducing the impact of injuries on an athlete’s function is to manage the pain cycle (figure 4.5).

The main examples of overuse injuries seen in athletes are summarised in table 4.4.

### TABLE 4.4 Types of overuse injuries

<table>
<thead>
<tr>
<th>Overuse injury</th>
<th>Signs and symptoms</th>
<th>Possible causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shin splints</td>
<td>Initial pain may be caused by slight inflammation in the muscles; over time, pain can become constant and extremely uncomfortable.</td>
<td>Poor posture; Excessive training during an adolescent growth spur or the beginning of a training program; Fallen arches in the feet; Biomechanically incorrect gait; Muscle fatigue in the lower limbs; A strength imbalance between anterior and posterior muscles in the lower leg</td>
</tr>
<tr>
<td>Osteitis pubis: irritation and/or overuse of the joint between the pubic bones of the pelvis</td>
<td>Gradual onset of groin pain with an increasing level of discomfort; Pain when kicking, running, twisting or completing turning movements; Pain when contracting abdominal muscles; Significant loss of kicking strength or length; Reduction in maximum running speeds</td>
<td>A combination of high running loads; frequent changing of direction at pace; the kicking action; muscle imbalance (abdominals)</td>
</tr>
<tr>
<td>Patellar tendonitis</td>
<td>Patellar tendon inflamed and tender; Pain often felt at the end of a session or when the athlete has cooled down</td>
<td>Running, jumping or high-impact activities; Growth spur</td>
</tr>
<tr>
<td>Tennis or golfer’s elbow</td>
<td>Recurring pain on the outside of the upper forearm just below the bend of the elbow; occasionally pain radiates down the arm towards the wrist; Difficulty extending the forearm fully because of inflamed muscles, tendons and ligaments; Pain caused by lifting or bending the arm or grasping even light objects such as a coffee cup</td>
<td>Poor technique; Equipment; Sudden increase in training/activity</td>
</tr>
</tbody>
</table>
Common sports injuries

An athlete can expect to suffer a number of different sports injuries during their career. The severity of each injury will vary greatly in terms of injury damage, recovery and rehabilitation. Some sports lend themselves to specific types of injuries. Table 4.5 shows the types of sporting injuries and their causes.

<table>
<thead>
<tr>
<th>Area of body</th>
<th>Cause of injury</th>
<th>Signs of injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>Concussion</td>
<td>Blow to the head or heavy fall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loss of consciousness; vomiting; loss of memory; headache or drowsiness</td>
</tr>
<tr>
<td>Chest</td>
<td>Winded</td>
<td>Heavy blow to the chest or abdomen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gasping for breath; pain; nausea</td>
</tr>
<tr>
<td>Abdomen</td>
<td>Stitch</td>
<td>Possible causes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ air bubbles in the duodenum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ spasms of the diaphragm</td>
</tr>
<tr>
<td>Shoulder</td>
<td>Dislocation</td>
<td>Falling on an outstretched arm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shoulder and arm in abnormal frontal position; resultant damage to ligaments and joint capsule; severe pain at point of injury; swelling</td>
</tr>
<tr>
<td></td>
<td>Broken clavicle (collarbone)</td>
<td>Falling on an outstretched arm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Need to support the elbow of the broken side</td>
</tr>
<tr>
<td>Elbow</td>
<td>Dislocation</td>
<td>Falling on an outstretched hand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deformity at elbow causing loss of movement; swelling; extreme pain</td>
</tr>
<tr>
<td>Hand/finger</td>
<td>Dislocated fingers</td>
<td>Direct blow to the hand/finger, usually caused by an object such as a ball or stick</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deformity; swelling; localised pain</td>
</tr>
<tr>
<td>Thigh</td>
<td>Cork (haematoma)</td>
<td>Direct contact with an object or body</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weakness in strength and power of the muscle; reduced range of motion; localised pain and swelling</td>
</tr>
<tr>
<td></td>
<td>Strain in quadriceps/hamstrings</td>
<td>Sudden over-stretching or contraction of muscle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sudden and severe localised pain when muscle is contracted; reduced mobility, strength and power</td>
</tr>
<tr>
<td>Knee</td>
<td>Patella dislocation</td>
<td>Forceful twist of knee while bearing weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deformity and loss of function of knee; extreme pain; swelling</td>
</tr>
<tr>
<td></td>
<td>Rupture of anterior cruciate or ligament sprain</td>
<td>Falling awkwardly and twisting knee</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sound of ‘pop’ or ‘crack’ in the knee; immediate pain in knee, which is sore to touch; some restricted movement</td>
</tr>
<tr>
<td></td>
<td>Torn cartilage (menisci)</td>
<td>As for sprain</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Swelling may be evident or occur later; other signs as for sprain</td>
</tr>
<tr>
<td>Ankle</td>
<td>Sprain</td>
<td>Twisting the ankle or playing on uneven surfaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Immediate pain in ankle, which is sore to touch; restricted movement; swelling</td>
</tr>
<tr>
<td></td>
<td>Achilles tendon rupture</td>
<td>Extremely powerful contraction of the calf muscles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Deformity of the Achilles tendon; a lump in the middle of the calf muscle; loss of movement of foot; pain</td>
</tr>
</tbody>
</table>
TEST your understanding
1 Outline the three classifications of injuries.
2 Discuss the difference between direct and indirect injuries. Provide examples.
3 Outline the difference between a strain and a sprain.
4 Is a dislocation an injury to hard tissue or to soft tissue?

APPLY your understanding
5 Apply the following questions to cricket, netball and tennis.
   (a) Identify injuries that are most likely to occur in these sports.
   (b) Provide examples of how these injuries might occur.
   (c) Classify the injuries as direct/indirect and soft/hard tissue injuries.
6 Read the following scenarios and classify them according to the type of injury most likely to have occurred.
   (a) A 100-metre sprinter begins his race accelerating from the blocks and feels a sharp pain in his Achilles tendon.
   (b) A basketballer jumps for a rebound but lands heavily and twists her ankle.
   (c) A tennis player feels discomfort in the elbow during a five-set match.
   (d) A footballer hears a crack as his leg collides with an opposing player’s leg while disposing of the football.
   (e) Two hockey players collide heads when going for the ball, and one complains of a headache.
   (f) A netballer trips over her opponent’s feet in the goal circle, puts her arms out to slow her fall and hurts her shoulder.

7 Learning activity: injury fact sheets
Smartplay is an Australian sports safety and injury prevention program that operates in several states. It has published injury fact sheets that can be viewed using the Smartplay weblink in your eBookPLUS.
Read the list of injury fact sheets and complete the following tasks.
   (a) Select two different acute injuries and read through their fact sheets.
   (b) For each injury, summarise the important information and record any interesting aspects of each injury.
   (c) Compile a 3-minute oral presentation on the two injuries you selected.

8 Practical activity: common sporting injuries
Choose a common team sport such as hockey or soccer to play as a class. While playing, consider all the injuries that could occur in the game.
   (a) The figure below shows the top ten most common injuries during sport. Suggest ways such injuries could occur in the sport you were playing.
   (b) Suggest ways of preventing or reducing these injuries.

Top ten most common injuries during sport

<table>
<thead>
<tr>
<th>Rank</th>
<th>Injury Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sprain or strain</td>
</tr>
<tr>
<td>2</td>
<td>Fracture, excludes tooth</td>
</tr>
<tr>
<td>3</td>
<td>Open wound, excludes eye</td>
</tr>
<tr>
<td>4</td>
<td>Injury to muscle or tendon</td>
</tr>
<tr>
<td>5</td>
<td>Superficial, excludes eye</td>
</tr>
<tr>
<td>6</td>
<td>Dislocation</td>
</tr>
<tr>
<td>7</td>
<td>Intracranial injury</td>
</tr>
<tr>
<td>8</td>
<td>Eye injury</td>
</tr>
<tr>
<td>9</td>
<td>Crushing injury</td>
</tr>
<tr>
<td>10</td>
<td>Foreign body</td>
</tr>
</tbody>
</table>

Source: Victorian Injury Surveillance Unit, Monash University Accident Research Centre.

Weblink
Smartplay
4.2 Illnesses associated with the musculoskeletal system

**KEY CONCEPT** Musculoskeletal illnesses and conditions can reduce the mobility of an individual and their capacity to remain physically active. There are preventative measures that can be taken to limit the effect of these conditions.

As well as injuries to the musculoskeletal system during physical activity, sport and exercise, there are many illnesses and conditions affecting both the muscular and skeletal systems that can impact on the ability of an individual to engage in regular physical activity.

The Australian Institute of Health and Welfare (AIHW) estimates that in 2011–12, 6.1 million Australians (28 per cent of the population) had a musculoskeletal condition. These conditions affect bones, muscles, joints and ligaments and often limit the capacity and mobility of an individual via reduced joint function, pain and psychological distress.

The most common musculoskeletal conditions in Australia include:
- arthritis (including osteoarthritis, juvenile arthritis and rheumatoid arthritis)
- osteoporosis
- back pain and problems.

**Arthritis**

Arthritis is characterised by inflammation of the joints in the body, causing pain and stiffness. It can impinge on the joint via weakness, instability and deformity around the joint structure. Arthritis is estimated to affect 3.5 million Australians (15.5 per cent), with more than half of those (58.9 per cent) suffering from osteoarthritis and 11.5 per cent with rheumatoid arthritis (AIHW, 2014). Arthritis more commonly affects females than males and prevalence increases with age, especially after 45 years. Arthritis can restrict the ability of an individual to engage in daily activities such as walking, preparing food and general hygiene.

There are over 100 forms of arthritis but the most significant ones affecting an individual’s ability to participate in physical activity are discussed below.

**Juvenile arthritis** describes the type of arthritis that occurs in children under 16 years of age. It is relatively uncommon, affecting less than 1 per cent of Australian children. Juvenile arthritis can be very unpredictable, changing from one moment where an individual can be symptom-free through to severe swelling, tenderness, stiffness and pain in and around the affected joints. Mobility can be compromised, making participation in physical activity difficult due to the unpredictable nature and flare up of symptoms. The cause of juvenile arthritis is currently unknown.

**Osteoarthritis** is a degenerative condition resulting from overuse, or ‘wear and tear’, of a joint, mostly affecting the weight-bearing joints of the hip, knee or ankle but can...
also affect the hands and spine. Cartilage on the ends of bones wears away causing the bones to rub together, creating pain, swelling and restriction of range of motion in the affected joint. Risk factors for developing osteoarthritis include increasing age, physical inactivity, being overweight, joint trauma from previous injuries and repetitive stress on a joint.

Rheumatoid arthritis is a chronic disease resulting from an autoimmune response of the body. The immune system attacks the tissues lining the joints causing pain, swelling, stiffness, progressive and irreversible damage, and deformity. Rheumatoid arthritis is the most severe form of arthritis, generally affecting the smaller joints of the body, such as the hands and feet.

For all forms of arthritis, regular physical activity has been found to improve the mobility and flexibility of joints, increase muscle strength and improve posture and balance as well as decrease pain, feelings of fatigue and tiredness, and muscle tension and stress. The added benefit of engaging in physical activity is also the improvement in overall health and maintenance of a healthy body weight. Excess body weight can contribute to symptoms of arthritis, especially in the weight-bearing joints of the body.

The type of physical activity should take into consideration the individual’s condition and limitations. Lower-impact exercises are often more comfortable as less force is going through the joints. These exercises might include:

- flexibility exercises, e.g. stretches, to maintain or improve the mobility of joints and muscles
- muscle strengthening, e.g. resistance training with weights, to develop strong muscles to support the joints and connective tissue
- aerobic activities, e.g. brisk walking and swimming, to improve heart and lung health.

### Osteoporosis

Osteoporosis is a musculoskeletal condition characterised by the thinning and weakening of a bone, making it very fragile. This occurs when the bone loses minerals, in particular calcium, quicker than the body can replace them. This loss impairs the density of the bone and increases the risk of fracture in comparison to a normal bone.

Osteoporosis affects 3.5 per cent of the Australian population. It is more common in women than men and has a higher incidence in people over the age of 55 (AIHW). It is often called the ‘silent disease’ as it has little to no symptoms and people may not know they have it until a fracture occurs. Once a fracture occurs, sufferers may have mobility concerns, especially if the fracture occurs in the spine, pelvis or lower limbs.

Osteoporosis is a largely preventable condition. Risk factors for developing osteoporosis include sedentary behaviour and lack of exercise, as well as nutritional concerns such as poor calcium intake and vitamin D deficiencies. Participation in

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Osteoporosis is a condition in which the bones become weak and thin and therefore brittle.

Weblink

Osteoporosis Australia
regular physical activities (particularly those that place ‘stress’ on the bone, such as weight-bearing activities) helps to maintain and/or improve bone density and strengthen the muscles that attach to these bones. Stronger bones and muscles improve posture and balance, and reduce the likelihood of falls and subsequent breaks in the bones.

Osteoporosis Australia outlines the following effects of exercise at different stages of life for the prevention or management of osteoporosis.

### TABLE 4.6 Exercise and its effects on osteoporosis

<table>
<thead>
<tr>
<th>Age</th>
<th>Bone status</th>
<th>Exercise effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Childhood/adolescence</td>
<td>In girls and boys the major build up of bone occurs in the pre-teen and adolescent years. Peak bone density is reached during mid to late 20s.</td>
<td>Can increase bone density and structure to maximise peak bone strength, which helps keep bones strong for longer in adulthood.</td>
</tr>
<tr>
<td>Early to mid adulthood</td>
<td>Bone density is maintained or starts to decrease very gradually when a person reaches their 30–40s although increases are still possible during middle adulthood.</td>
<td>Can maintain or increase (1–3%) bone density and improve cardiovascular health and fitness; resistance training can also improve muscle mass and strength.</td>
</tr>
<tr>
<td>Post menopausal women</td>
<td>In women from the age of 45 years, bone loss begins to increase to 1–2% per year. Bone loss accelerates up to 2–4% per year at the onset of menopause.</td>
<td>Can maintain bone strength by helping to slow the rate of bone loss following menopause. It is very difficult to increase bone density during or after menopause by exercise alone. Can effectively improve muscle function (balance) and reduce falls risk.</td>
</tr>
<tr>
<td>Men</td>
<td>Bone density tends to remain relatively stable until middle age, decreasing by about 0.5–1.0% per year from the age of 45–55 years. Low testosterone or hypogonadism can increase bone loss in men.</td>
<td>Can maintain or increase (1–2%) bone density, improve muscle mass, strength, balance and co-ordination to help prevent falls and maintain general health.</td>
</tr>
<tr>
<td>Older adults without osteoporosis</td>
<td>After 75 years of age, further increases in bone loss occur in both sexes, especially from the hip. The risk of fracture increases as bone loss increases.</td>
<td>Helps to maintain bone strength and increase muscle strength, balance and co-ordination, which in turn help to prevent falls.</td>
</tr>
<tr>
<td>Older adults with osteoporosis/fractures</td>
<td>Bones are increasingly thin and fragile.</td>
<td>Exercises recommended by physiotherapists and exercise physiologists can improve general health, muscle strength, balance and posture to prevent falls and reduce the risk of further fractures.</td>
</tr>
</tbody>
</table>

**Source:** Osteoporosis Australia, www.osteoporosis.org.au.

### Back pain

Back pain and back problems can affect the bones, joints, tissues and nerves of the back. They can be caused by a variety of mechanisms, including soft tissue injury (e.g. muscle strain or sprains), displacement of intervertebral discs, postural stress, nerve irritations (e.g. sciatica) and structural problems. Back problems often stem from overuse, injury, weakness, degeneration or postural misalignment.
Back pain can be acute, but more often than not it can become chronic and long lasting. It is estimated that 2.8 million Australians (13.6 per cent) are affected by back pain (AIHW, 2011–12).

Risk factors for back pain include sedentary behaviour and physical inactivity, being overweight or obese, type of occupation (especially those that involve lifting, bending or twisting), poor posture and stress. Other musculoskeletal conditions, such as osteoarthritis and osteoporosis, can also be risk factors for and contribute to back pain.

Treatment to help prevent back pain includes:
- exercises to strengthen the back and core muscles, to assist with correct posture and support of the spine
- maintaining a healthy weight, as excess weight puts strain on the back and postural muscles
- staying active.

**TABLE 4.7** Summary of risk factors and preventative measures for a range of musculoskeletal conditions

<table>
<thead>
<tr>
<th>Musculoskeletal conditions</th>
<th>Description</th>
<th>Risk factors</th>
<th>Preventative measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rheumatoid arthritis</td>
<td>Chronic disease of the joints causing pain, swelling, stiffness, and irreversible damage and deformity</td>
<td>Age, Gender (female), Family history, Tobacco use</td>
<td>Regular participation in physical activity, Not smoking, Healthy diet</td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>Degenerative condition resulting from overuse of a joint where cartilage wears away, causing bones to rub together</td>
<td>Increasing age &gt; 45 years, Physical inactivity, Overweight/obesity, Joint trauma from previous injury, Repetitive stress on a joint</td>
<td>Regular participation in physical activity, Maintenance of healthy body weight</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>Characterised by thinning and weakening of the bone, making it very fragile</td>
<td>Sedentary behaviour, Physical inactivity, Poor calcium intake, Vitamin D deficiency, Increasing age &gt; 55 years, Gender (female)</td>
<td>Regular participation in weight-bearing activities, Nutritious diet, including calcium</td>
</tr>
<tr>
<td>Back pain</td>
<td>Pain affecting bones, joints, tissue and nerves of the back stemming from overuse, injury, weakness or degeneration</td>
<td>Sedentary behaviour, Physical inactivity, Overweight/obesity, Poor posture, Type of occupation</td>
<td>Limiting sedentary behaviour, Regular participation in physical activity, Maintenance of healthy body weight</td>
</tr>
</tbody>
</table>
4.2 Illnesses associated with the musculoskeletal system

TEST your knowledge
1. What is a musculoskeletal illness or condition?
2. List the common musculoskeletal illnesses or conditions and indicate the percentage of Australians affected by each of these conditions.
3. Outline the difference between the three most common types of arthritis.
4. Osteoporosis is largely a preventable condition. Discuss this statement.

APPLY your knowledge
5. Outline the similarities and differences between the musculoskeletal illnesses and conditions discussed in this section.
6. For each of the musculoskeletal illnesses and conditions outlined in question 5, suggest ways to prevent these conditions occurring.
7. Create a fact sheet for one of the musculoskeletal illnesses, outlining:
   - what the condition is
   - how a person can develop the illness
   - how many Australians suffer from the illness
   - any preventative measures that can reduce the likelihood of developing the illness
   - health promotion programs that address the illness.
**KEY CONCEPT:** A range of strategies can be used to assist the athlete to be physiologically prepared for participation in physical activity, sport and exercise, and reduce the incidence of injury.

Sustaining an injury is one of the risks involved in participating in competitive sport, physical activity and exercise. Factors such as age, gender, health, physical fitness, skill level, sports equipment and the environment can all influence the potential for injury. It is estimated that up to 50 per cent of sporting injuries are preventable. A proactive approach to **sports injury prevention** will reduce the likelihood of injury occurring.

There is a correlation between the characteristics of certain sports and the increased risk of injury to athletes. High-risk characteristics include:
- high levels of physical contact
- high impact activity
- heavy physical demands requiring maximal exertion
- high training volume, e.g. swimming and gymnastics which require six to nine sessions per week
- long seasons of competition or no breaks between seasons.

The physical preparation of an individual is the key to prevention of injury. Through appropriate preventative strategies, the individual is better placed to participate in their sport, physical activity or exercise, and reduce their risk of injury. Preventative actions include:
- performing pre-participation screening
- developing physical fitness appropriate to the activity
- developing correct skills and techniques
- completion of adequate warm-up, stretching and cool-down procedures.

Individuals need to be aware of these to ensure that they are in peak condition to participate in their chosen physical activity, sport or exercise.

**Pre-participation screening**

Pre-participation screening should be undertaken by all individuals prior to commencing or increasing their physical activity, whether that is a health and fitness program or competitive sport. Pre-participation screening can take the form of questionnaires and/or physical examinations. Questionnaires are the most common form of screening and are designed to ask about the medical history of athletes and may include questions relating to current medical conditions, allergies, family histories and previous injuries. Physical examinations provide data on parameters such as height, weight and blood pressure.

Figure 4.9 is an example of an adult pre-participation screening questionnaire produced by Exercise and Sports Science Australia (ESSA), Fitness Australia and Sports Medicine Australia. This form is specifically designed to identify individuals with underlying health concerns or at high risk of something going wrong during exercise.
ADULT PRE-EXERCISE SCREENING TOOL

This screening tool does not provide advice on a particular matter, nor does it substitute for advice from an appropriately qualified medical professional. No warranty of safety should result from its use. The screening system in no way guarantees against injury or death. No responsibility or liability whatsoever can be accepted by Exercise and Sports Science Australia, Fitness Australia or Sports Medicine Australia for any loss, damage or injury that may arise from any person acting on any statement or information contained in this tool.

Name: ____________________________  Male: [ ]  Female: [ ]  Date: ________________

STAGE 1 (COMPULSORY)

AIM: To identify those individuals with a known disease, or signs or symptoms of disease, who may be at a higher risk of an adverse event during physical activity/exercise. This stage is self administered and self evaluated.

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Has your doctor ever told you that you have a heart condition or have you ever suffered a stroke?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Do you ever experience unexplained pains in your chest at rest or during physical activity/exercise?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. Do you ever feel faint or have spells of dizziness during physical activity/exercise that causes you to lose balance?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4. Have you had an asthma attack requiring immediate medical attention at any time over the last 12 months?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5. If you have diabetes (type I or type II) have you had trouble controlling your blood glucose in the last 3 months?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>6. Do you have any diagnosed muscle, bone or joint problems that you have been told could be made worse by participating in physical activity/exercise?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7. Do you have any other medical condition(s) that may make it dangerous for you to participate in physical activity/exercise?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

IF YOU ANSWERED ‘YES’ to any of the 7 questions, please seek guidance from your GP or appropriate allied health professional prior to undertaking physical activity/exercise.

IF YOU ANSWERED ‘NO’ to all of the 7 questions, and you have no other concerns about your health, you may proceed to undertake light-moderate intensity physical activity/exercise.

I believe that to the best of my knowledge, all of the information I have supplied within this tool is correct.

Signature ____________________________  Date ________________
ADULT PRE-EXERCISE SCREENING TOOL

STAGE 2 (OPTIONAL)

Name: __________________________ Date of Birth: __________________________

Date: __________________________

AIM: To identify those individuals with risk factors or other conditions to assist with appropriate exercise prescription. This stage is to be administered by a qualified exercise professional.

1. **Age Gender**
   - **Risk factors**
   - ≥45 yrs Males or ≥55 yrs Females +1 risk factor

2. **Family history of heart disease (e.g. stroke, heart attack)**
   - **Relative**
     - Father: ________  Mother: ________
     - Brother: ________  Sister: ________
     - Son: ________  Daughter: ________
   - **Risk factors**
   - If male < 55 yrs = +1 risk factor
   - If female < 65 yrs = +1 risk factor
   - Maximum of 1 risk factor for this question

3. **Do you smoke cigarettes on a daily or weekly basis or have you quit smoking in the last 6 months? Yes No**
   - If currently smoking, how many per day or week?
   - Yes, (smoke regularly or given up within the past 6 months) = +1 risk factor

4. **Describe your current physical activity/exercise levels:**
   - **Sedentary Light Moderate Vigorous**
   - **Risk factors**
   - If physical activity level < 150 min/week = +1 risk factor
   - If physical activity level ≥ 150 min/week = -1 risk factor
   - (vigorous physical activity/exercise weighted × 2)
   - Frequency
     - sessions per week ________
   - Duration
     - minutes per week ________

5. **Please state your height (cm) ________ weight (kg) ________**
   - **BMI = ________**
   - BMI ≥ 30 kg/m² = +1 risk factor

6. **Have you been told that you have high blood pressure? Yes No**
   - If yes, = +1 risk factor

7. **Have you been told that you have high cholesterol? Yes No**
   - If yes, = +1 risk factor

8. **Have you been told that you have high blood sugar? Yes No**
   - If yes, = +1 risk factor

STAGE 2 Total Risk Factors = __________________________

**FIGURE 4.10** Pre-participation screening tool

Source: essa.org.au

CHAPTER 4 • Acute and chronic injuries and illnesses of the musculoskeletal system 73
4.3 Physiological strategies to prevent musculoskeletal injuries

Physical preparation of athletes
Training should always ensure athletes achieve appropriate fitness levels that are specific to the sport. Athletes and coaches must correctly apply the principles of training — particularly those of specificity, appropriate progressive overload, intensity and frequency — during both the pre-season and in-season training. It is important that the athlete’s preparation is thorough, but not so demanding as to cause overtraining. Adequate recovery between training sessions is vital for the athlete to benefit from the session as well as prevent injury from occurring. Fatigue is one of the most common causes of injury, but physically fit athletes do not fatigue as quickly. Fitness testing in the pre-season phase will allow the coach to identify the strengths and weaknesses of individual athletes, and prepare specialised training for each individual.

Warm-up
A warm-up prepares the body for physical activity. Physiologically, a warm-up:
- increases heart rate and respiratory rate, resulting in increased delivery of oxygen to working muscles
- increases blood flow to muscles, resulting in an increase in muscle temperature and an increase in oxygen delivery to the muscle cells
- increases extensibility of the muscle fibres (and tendons) due to the increase in muscle temperature
- increases enzyme activity within the muscle cells due to increased muscle temperature, facilitating improved energy release within the muscle.

Psychologically, it prepares the mind for competition by increasing focus, attention and concentration.

The type of activity being undertaken should determine the type of warm-up conducted. All warm-ups include a general phase followed by a sport-specific phase.
- The general phase (beginning of the warm-up) should include low-impact aerobic activities, such as jogging, that are continuous in nature, as well as stretching.
- The sport-specific phase should include activities directly related to the muscles, joints and body parts about to be used in the activity. These activity-related movements should be dynamic movements and could involve activities such as:
  - run-throughs
  - high knee-lift running
  - horizontal ladder stepping
  - skill drills that replicate the specific movement patterns performed during the sport or activity; for example, kicking a football.

Overtraining refers to a physical condition characterised in its most severe form by decreased athletic performance, increased fatigue, persistent muscle soreness, mood disturbances, and a feeling of being ‘burnt-out’ or ‘stale’.

Warm-up refers to activities and exercise undertaken at the beginning of a training session with the aim of preparing the body both physiologically and psychologically for the training session that follows.

FIGURE 4.11 Activities that can be completed in a warm-up
By warming up the muscles, the risk of injury is reduced, particularly muscle strains and tears. This is due to the fact that there is an increased range of motion around the joint and decreased stiffness of the surrounding connective tissue.

There is no set duration for a warm-up, however the athlete should be guided by how they feel. A general guideline is that the warm-up should produce mild sweating without fatigue. The length of the warm-up is related to weather temperature and, in warmer conditions, the time needed for an adequate warm-up is generally much less than in cooler conditions.

**Cool-down**

The *cool-down* assists the body to recover from exercise via completion of a low-intensity version of the activity just participated in. It is a gradual reduction in the intensity of the activity being performed, followed by a period of static and proprioceptive neuromuscular facilitation (PNF) stretching of the major muscles used in the activity.

The main aims of the cool-down are:
- prevent venous pooling (accumulation of blood in the veins)
- ensure that waste products, such as lactic acid, are broken down and removed from the blood
- reduce the potential for muscle soreness
- allow the body to return to its resting physiological state.

The length of a cool-down can vary depending on the athlete and type of activity undertaken. It is the first stage in the recovery process.

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**Fighting sporty kids’ arthritis risk**

**BY CATHY JOHNSON**

Sports injuries in kids can leave a lasting legacy: arthritis later in life. However, some simple exercises can dramatically reduce the risk.

There’s no denying sport is an important part of a healthy childhood.

But when injuries strike, there’s a hidden toll many parents are unaware of. Your child’s pain can return years down the track in the form of osteoarthritis, or damaged joints. The disease makes joints stiff and sore and can reduce mobility — sometimes significantly.

In fact research has shown sporting injuries in childhood are responsible for around 20 per cent of osteoarthritis cases in adults, some of whom are as young as 30.

With osteoarthritis affecting two million Australians, that’s close to half a million people who can link their condition to childhood sport.

According to research published in 2011, the sports with the greatest number of injuries predisposing to arthritis in later life are soccer, Australian football (‘Aussie Rules’) and netball. This is partly due to their popularity and the fact they involve sudden changes in direction that tend to create knee injuries. Players aged 15 to 24 are most commonly affected.

The good news is some simple workouts could help prevent the injuries occurring in the first place, says Sydney arthritis expert Professor David Hunter, a staff specialist at Sydney’s Royal North Shore Hospital.

If a 10 to 20 minute injury prevention routine was part of training for all school and community sports, it could substantially reduce the number of injuries and therefore future arthritis sufferers, Hunter says.

In Norway, such a scheme produced a drop in injuries as high as 60 per cent and the effectiveness of programs has been documented in several scientific journals.

Prevention programs are rare in Australia but Hunter is part of a group pushing for them to become standard in sporting groups across the country.

Until that happens, he says parents can take the lead. ‘Parents have a strong influence over what coaches ultimately do. Or they can just make sure their own kids do the right exercises at home. We want to encourage kids’ involvement in sport, but we want to make sure it’s done in a safe way.’

**Right exercises cut risk**

Ideally Hunter would like to see detailed injury prevention routines developed for specific sports. These could then be incorporated into coach education systems, with coaches ensuring the routines are performed correctly by players during training.

Soccer’s international governing body, the Federation International Football Association (FIFA), has developed a program suitable for its players, although it hasn’t been adopted widely by coaches in Australia.

However, Hunter says parents can help their children reduce their risk of injury by encouraging them to do five of the FIFA program’s exercises, which are helpful for players of any sport. He suggests children do these exercises twice a week, ideally on a sporting field or park where there is plenty of space.
### Exercises

**Walking lunges**

Stand with your feet hip-width apart and lunge forward slowly at an even pace across a distance (approx. 10 times each leg) and then jog back. Do this twice (i.e. 2 sets).

<table>
<thead>
<tr>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bend your leading knee to 90 degrees</td>
<td>• Your bent knee should not extend beyond your toes</td>
</tr>
<tr>
<td>• Keep your upper body upright</td>
<td>• Do not let your leading knee buckle inwards</td>
</tr>
<tr>
<td>• Keep your pelvis horizontal</td>
<td>• Do not bend your upper body forwards</td>
</tr>
<tr>
<td></td>
<td>• Do not twist or tilt your pelvis to the side</td>
</tr>
</tbody>
</table>

**Lateral jumps**

Stand on one leg with your upper body bent slightly forwards from the waist, with knees and hips slightly bent. Jump approx. 1m sideways from the supporting leg on to the free leg, maintaining your balance. Repeat, changing legs each time. Do 2 sets of 30 secs each.

<table>
<thead>
<tr>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>• When viewed from the front, your hip, knee and foot should be in a straight line</td>
<td>• Do not let your knee buckle inwards</td>
</tr>
<tr>
<td>• Land gently on the balls of your foot, bend the hip, knee and ankle at the same time and lean your upper body forwards</td>
<td>• Do not turn your upper body</td>
</tr>
<tr>
<td>• Keep your upper body stable and facing forwards</td>
<td>• Do not twist or tilt your pelvis to the side</td>
</tr>
<tr>
<td>• Keep your pelvis horizontal</td>
<td></td>
</tr>
</tbody>
</table>

**Box jumps**

Stand with your feet hip-width apart and imagine there is a cross marked on the ground and you are standing in the middle of it. Alternate between jumping forwards and backwards, from side to side, and diagonally across the cross. Jump as quickly and explosively as possible. Do 2 sets of 30 secs each.

<table>
<thead>
<tr>
<th>Correct</th>
<th>Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>• When viewed from the front, the hip, knee and foot of both legs should be in two straight parallel lines</td>
<td>• Never let your knees meet and do not let them buckle inwards</td>
</tr>
<tr>
<td>• Jump off both feet and land on the balls of your feet with feet hip-width apart</td>
<td>• Do not land with extended knees or on your heels</td>
</tr>
<tr>
<td>• Bend your hips, knees and ankles on landing</td>
<td></td>
</tr>
<tr>
<td>• A cushioned landing and a powerful take-off are more important than how high you jump</td>
<td></td>
</tr>
</tbody>
</table>
Take a few warm-up steps then take 6-8 bounding steps with a high knee lift before slowing to a jog. Use an exaggerated arm swing for each step (opposite arm and leg). Try not to let your leading leg cross the midline of your body. Jog back to recover.

Do this twice (i.e. 2 sets).

Correct

- Keep your upper body straight
- Land on the ball of the leading foot with the knee bent and spring

Incorrect

- Do not let your knee buckle inwards

Plant cut

Jog 4-5 steps, then “plant” on the right leg (i.e. firmly place your right foot on the ground) and “cut” to change direction to the left and accelerate. Sprint for 5-7 steps (at 80-90% of maximum pace) before you decelerate and plant on the left foot to cut to change direction to the right. Repeat for a distance of about 70 metres or so then jog back.

Do this twice (i.e. 2 sets).

Correct

- Make sure you keep your upper body straight
- Your hips, knees and feet should be aligned

Incorrect

- Do not let your knees buckle inwards

These descriptions are based on those outlined in FIFA’s injury prevention program 11+.

The arthritis time bomb

A variety of injuries can predispose a child to arthritis later in life, including severe ankle sprains and tears to the menisci (discs of cartilage on either side of the knee). However, one injury that stands out as particularly problematic is a tear to a major ligament in the knee, the anterior cruciate ligament, Hunter says.

He recommends the five exercises with this in mind. They help sports players strengthen their ankles and learn to land with straight knees. This prevents sudden lurches to the side that impose forces up to 10 times your body weight.

‘Of the 20,000 Australians who tear their cruciate ligament each year, about 70 per cent will get osteoarthritis in that knee within 10 to 20 years, irrespective of the treatment they undergo.’

While a torn anterior cruciate ligament can be repaired surgically with a recuperation period of six to 12 months, the initial injury changes the stability of the knee joint so that ‘different parts of the joint that weren’t previously in contact with each other are now touching,’ Hunter says.

Over time, cartilage and other tissues in the joint start to be ‘overwhelmed’ and start to break down, causing the symptoms of pain and stiffness.

‘If we use imaging techniques to follow people [who have injured their cruciate ligament], their joint basically never returns to normal,’ Hunter says. ‘Even though the ligament repairs, it doesn’t necessarily make everything else get back to normal.’

‘So a lot of people are getting osteoarthritis in their early and mid-30s as a result of an injury that might have happened in their teens. And most of those people do become quite disabled.’

Prevention is best

Unfortunately there’s little you can do to prevent arthritis developing once you’ve had a cruciate ligament injury, Hunter says — hence the focus on prevention.

Some parents believe, incorrectly, if their child avoids sports involving heavy contact with other players, they will not be at risk.

‘People are misled into thinking these injuries occur during heavy contact in violent sport. But the overwhelming majority of them aren’t contact injuries, they’re a person landing on the knee improperly with no-one even standing near them and the ligament just tears.’

But he urges parents not to let fear of injuries lead them to hold their child back from playing sport.

‘Physical activity is healthy and we want kids to do it. And injury prevention is a tangible realistic goal.’

Source: www.abc.net.au, 23 May 2012.
4.3 Physiological strategies to prevent musculoskeletal injuries

**TEST your knowledge**
1. List the factors that can contribute to an athlete sustaining an injury.
2. Outline the role of pre-participation screening.
3. Explain how the following can help prevent injury:
   - (a) adequate fitness
   - (b) warm-up
   - (c) cool-down.

**APPLY your knowledge**
4. **Practical activity: warm-up/cool-down**
   - (a) Working in pairs, plan a warm-up or cool-down for a sport of your choice.
   - (b) Conduct the session for the class.
   - (c) Explain to the class how each activity completed will help reduce the risk of injury.

5. **Learning activity: injury prevention**
The figure below shows the top ten most injury-prone sports. Choose three sports from this list.
   - (a) List all the injuries that could occur in the three sports.
   - (b) Identify all the risks that you think could contribute to injuries sustained in the three sports.
   - (c) Outline injury prevention measures for each injury identified.

<table>
<thead>
<tr>
<th>Top ten most injury prone sports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Australian Rules football</td>
</tr>
<tr>
<td>2. Basketball</td>
</tr>
<tr>
<td>5. Cricket</td>
</tr>
</tbody>
</table>

**Source:** Victorian Injury Surveillance Unit, Monash University Accident Research Centre.

6. **Learning activity: ‘Fighting sporty kids’ arthritis risk’**
Read the article on pages 75–7 and use your knowledge to answer the following questions.
   - (a) Explain the link between sport, injury and osteoarthritis.
   - (b) Identify and classify the types of injuries discussed in the article.
   - (c) Outline preventative measures discussed in this article that could reduce the chance of injury occurring.
4.4 Physical aids to support the musculoskeletal system

**KEY CONCEPT:** Protective equipment, taping and braces are widely used by individuals to provide additional protection from sustaining an injury during physical activity, sport and exercise

**Protective equipment**

Most sporting activities use protective equipment designed to reduce the risk of injury to participating athletes, especially the effect of impact and collisions. Some safety equipment is compulsory but much of it is used voluntarily. It is important that all protective equipment:
- Is worn during training and games
- Fits correctly
- Is specific and appropriate for the sport, size and age of athlete
- Is regularly checked and maintained.

Protective equipment can cover all parts of the body. It is designed to feel comfortable for the athlete and to not interfere with sporting activity. Protective equipment can be used as a preventative measure prior to an injury occurring or on return to sport where there may be risk of aggravating an old injury. Table 4.7 outlines a range of protective equipment that can be worn across a wide variety of sports.

While protective equipment is designed to prevent injury, there are instances where this may not occur. In November 2014, Australian cricketer, Philip Hughes was struck by a cricket ball on the back of his neck just below his helmet during a Sheffield Shield match. The blow to his neck led to a haemorrhage, and, tragically, he died two days later in hospital. The Australian cricket community was in shock that such a tragedy could happen on the field and subsequently, many questions were asked about the safety of equipment used and emergency medical care on field.

Hughes was wearing a Masuri-branded helmet when the accident occurred. At that time there was no helmet that could have protected Hughes from the ball hitting an artery in his neck. Masuri has since released a new helmet with greater protection in an effort to prevent another tragic death. It features a clip-on ‘StemGuard’ made of plastic and foam to help protect the back of the neck. This year, players from Sri Lanka and Australia have been trialling the StemGuard attachment.
4.4 Physical aids to support the musculoskeletal system

Correct footwear

Many sports require different types of footwear depending on the demands of the sport and the surface being played on. Specialised footwear can include running shoes, spikes and football boots. A good running shoe will help prevent injuries such as shin splints, overpronation and underpronation of the foot, and Achilles tendon problems. For example, running shoes should have the following characteristics:

- a good grip on the playing surface
- stability that allows quick changes of direction
- cushioning for shock absorption, such as gel pads or air bladders
- flexibility to allow the foot to flex
- comfort for the wearer
- correct fit.

Shoes should be laced properly before activity to allow a firm fit around the foot. A podiatrist may prescribe orthotics for athletes with congenital defects such as flat feet, high arches, unequal leg length, and overpronation or underpronation. Orthotics inserted into the shoe will prevent ongoing injury. Figure 4.15 describes how to choose sports shoes.

Be specific
No single pair of shoes is right for all activities. Look for shoes designed to reduce and absorb the unique stresses and forces placed on your foot in your chosen activity.

Good cushioning
The importance of cushioning will depend on your injury history, and the type of surface you are exercising on, such as grass or concrete. Look for adequate forefoot and mid-foot cushioning for shock absorption.

Heel support
The structure at the back of the shoe that cups the heel should be firm and wide enough to provide a stable platform for the foot. This is especially important for sports that involve lateral motion, like tennis and basketball. The shoe should also have a notch at the top back of the shoe to prevent rubbing on your Achilles tendon.

Ask for help
Everybody's feet are different. Specialty shoe stores will have a variety of brands, features and styles to choose from, and have staff trained to help you select the right shoe for your activity and anatomy. If you have any injury concerns, it may help to see a podiatrist, who can assess your feet, and recommend the best shoes for you.

Replace old shoes
Shoe wear depends on your foot anatomy, body weight, type of exercise, frequency of training and the training surface. Don’t wait till your shoes are completely worn out before buying another pair. They can look clean, but most shoes lose their cushioning after 12 months of use. Inner soles can also be replaced to help absorb your weight.

FIGURE 4.14 The new Masuri helmet, featuring the StemGuard attachment, which provides greater protection to the back of the head and neck.

FIGURE 4.15 How to choose sports shoes
Source: Andrew Cate, exercise physiologist, from ABC Health & Wellbeing, www.abc.net.au.
Taping

Preventative taping (or strapping) and bandaging of joints before playing or training can reduce the chance of injury and the severity of a ligament injury or strain. Taping is used to restrict some potentially harmful movements while allowing the desired movement of a joint or muscle during activity.

Taping can be used as a preventative measure, especially in high-risk activities, such as ankles in netball, or in rehabilitation after an injury has occurred to protect the injured site during the healing phase and prevent further injury. It can also be used to enhance proprioceptive feedback from the affected site, especially when there has been previous injury to the site.

There are many types of tapes and bandages on the market to be used by athletes. Rigid strapping tape is used if the athlete is wanting to restrict movement and provide mechanical support and proprioception. Soft elastic bandages are used for initial injury, especially when wanting to compress soft tissue and reduce swelling to the affected area. Basic taping techniques include anchors, stirrups, figure of six and figure of eight (see Taping techniques weblink in your eBookPLUS for more information).

Whilst taping offers many benefits, potential harms can include irritation of the skin and reduced circulation if too tight. Tape does also lose elasticity over time, and therefore can become less effective than when initially applied. Taping can be applied by athlete but is often applied by medical professionals.

Kinesiology taping

An alternative form of tape is kinesiology tape. This tape is thinner and more elastic than traditional rigid strapping tape. It is a less restrictive type of taping that allows muscle support while not compromising range of joint motion. The tape is not completely wrapped around the injured joint or muscle, but applied over or on the periphery of these areas. Benefits of this type of taping are thought to include pain relief, greater range of motion and the ability to be worn for longer than rigid strapping tape.

The tape is applied in different techniques to rigid strapping with three general shapes:
- an ‘I’ shape where the tape is applied linearly
- a ‘Y’ shape for larger muscles, such as the deltoid across the shoulder
- an ‘X’ shape for large and long muscles such as down the hamstring on the biceps femoris.
Braces

Sports braces play a similar role to taping in the prevention of sports injuries, with the added advantage of the athlete being able to put on the brace themselves rather than relying on a professional to tape the affected joint. While they can be expensive, a good quality brace will last longer and may be cheaper in the long term if the athlete needs to repeatedly tape an area.

As well as being used for the prevention of sporting injuries, taping, bandages and braces can also be used for the musculoskeletal conditions outlined in section 4.2, especially for arthritic joints and back pain.

**TABLE 4.8** Protective equipment used in a variety of sports

<table>
<thead>
<tr>
<th>Protective equipment</th>
<th>Sports used in (examples)</th>
<th>Potential injury prevented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouthguard</td>
<td>Boxing</td>
<td>Dental injury</td>
</tr>
<tr>
<td></td>
<td>Collision sports (e.g. hockey, netball, basketball)</td>
<td>Teeth knocked out, chipped, broken, displaced</td>
</tr>
<tr>
<td></td>
<td>Football codes (AFL, soccer, rugby)</td>
<td>Mandible (jaw) injury</td>
</tr>
<tr>
<td>Goggles/glasses</td>
<td>Skiing</td>
<td>Eye injury</td>
</tr>
<tr>
<td></td>
<td>Squash</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Swimming</td>
<td></td>
</tr>
<tr>
<td>Helmet/face shield</td>
<td>Baseball/softball</td>
<td>Broken jaw, facial bones</td>
</tr>
<tr>
<td></td>
<td>Cycling</td>
<td>Skull fracture</td>
</tr>
<tr>
<td></td>
<td>Cricket (wicketkeeper, slips)</td>
<td>Facial lacerations</td>
</tr>
<tr>
<td></td>
<td>Fencing</td>
<td>Concussion</td>
</tr>
<tr>
<td></td>
<td>Football codes (soft helmet)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gridiron</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hockey (goalie)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Horse racing (jockey)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ice hockey</td>
<td></td>
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<tr>
<td></td>
<td>Snowboarding</td>
<td></td>
</tr>
<tr>
<td>Lower leg/shin padding</td>
<td>Baseball/softball (catcher)</td>
<td>Lower limb contusion</td>
</tr>
<tr>
<td></td>
<td>Cricket</td>
<td>Broken bones in lower leg/ankle</td>
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<tr>
<td></td>
<td>Hockey</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soccer</td>
<td></td>
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<tr>
<td></td>
<td>Volleyball</td>
<td></td>
</tr>
<tr>
<td>Upper body/chest padding</td>
<td>Baseball/softball (catcher)</td>
<td>Broken/fractured ribs</td>
</tr>
<tr>
<td></td>
<td>Cricket</td>
<td>Contusion</td>
</tr>
<tr>
<td></td>
<td>Fencing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gridiron</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hockey (goalie)</td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td>Boxing</td>
<td>Broken/fractured/dislocated fingers</td>
</tr>
<tr>
<td></td>
<td>Cricket</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hockey (goalie)</td>
<td>Contusion</td>
</tr>
<tr>
<td>Wrist/forearm guard</td>
<td>In-line skating</td>
<td>Broken/fractured wrist</td>
</tr>
<tr>
<td></td>
<td>Snowboarding</td>
<td></td>
</tr>
<tr>
<td>Footwear</td>
<td>Athletics (spikes)</td>
<td>Shin splints</td>
</tr>
<tr>
<td></td>
<td>Basketball</td>
<td>Strains/sprains</td>
</tr>
<tr>
<td></td>
<td>Baseball</td>
<td>Stress fractures</td>
</tr>
<tr>
<td></td>
<td>Boxing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cricket</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Football codes (AFL, soccer, rugby)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Golf</td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 4.18** A knee brace provides extra support during physical activity.
TEST your understanding
1 Discuss the important considerations for the use of protective equipment in sport.
2 Explain why correct footwear is important for the prevention of injury.
3 Outline the purpose of taping and braces.

APPLY your understanding
4 (a) Choose a sport and list all the protective equipment that is available for playing that sport.
   (b) Outline why each piece of equipment has been introduced.
   (c) Explain the potential injury prevented by each piece of equipment.
   (d) Outline how each piece of equipment protects the athlete.
   (e) Nominate whether the equipment is compulsory or optional.

5 Practical activity: taping
   The aim of this activity is to teach students how to tape a sports injury.
   Equipment
   - rolls of thick (38 mm) and thin (12 mm) masking tape
   - undertape (to protect skin and hair)
   Method
   Instructions on taping an ankle can be viewed using the ‘How to tape’ eLesson in your eBookPLUS.
   Listen to the instructions and then complete the following.
   (a) In pairs, discuss the main points concerning the taping of the ankle.
   (b) Use the masking tape to tape your partner’s ankle.
   (c) Swap over so your partner can tape your ankle.
   Results
   Compare your taping efforts with other class members and have the teacher assess your efforts and give feedback.

eLesson
How to tape
Searchlight ID: eles-0461
CHAPTER 4 REVISION

KEY SKILLS

- Examine a variety of causes of musculoskeletal injuries
- Describe and implement the correct application of techniques and physiological strategies in a variety of sporting activities to maintain optimal functioning of the musculoskeletal system.

UNDERSTANDING THE KEY SKILLS

To address these key skills, it is important to remember the following:

- Injuries can be classified as acute, chronic and overuse.
- Injuries can be caused by an external force (direct contact) or an internal force (indirect contact) and can affect the hard or soft tissue of the body.
- Physiological strategies to prevent injury include physical preparation of the athlete, warm-up and cool-down.
- Physical aids such as protective equipment, taping and bracing can support the optimal functioning of the musculoskeletal system.

PRACTICE QUESTION

(adapted from ACHPER 2015 Unit 1 exam, question 1)

Australian Cricket Captain Michael Clarke’s 2014–15 summer was hampered by a number of injuries. During day one of the First Test in Adelaide, Clarke was forced to retire hurt by a degenerative back condition after he twisted to avoid a ball. Clarke has three degenerative discs in his lower back that were first diagnosed when he was a teenager. Clarke then suffered a tear in one of the tendons of his right hamstring while performing an off-balance throw fielding a ground ball on day five of the test.

1. a. **Classify** each of Clarke’s injuries described above. (2 marks)
   i. Back injury
   ii. Hamstring injury
   b. i. **Explain** why a tear such as that experienced by Clarke in his right hamstring occurs. (1 mark)
   ii. Other than the fielding example above, describe an example of how this type of injury could happen whilst playing cricket. (1 mark)
   c. **Discuss** a preventative measure that Clarke could have taken to reduce the risk of his back injury reoccurrence. (2 marks)

Sample response

- i. Chronic injury
- ii. Acute injury
- i. Tears occur when **connective tissue**, in Clarke’s case a hamstring tendon, is excessively stretched due to not being able to handle the stress placed on it.
- ii. Examples could include **accelerating quickly**;
  - to run between the wickets while batting
  - during a bowler’s runup to bowl.
- c. Answer must relate to preventative measures such as warm-up, physical preparation, taping.

PRACTISE THE KEY SKILLS

1. Describe each of the three classifications of injuries and how they occur.
2. Outline a physiological strategy that could be utilised to reduce the risk of sustaining an injury in physical activity, sport and exercise.
3. Discuss two physical aids that could be used to prevent injuries in sport.

KEY SKILLS EXAM PRACTICE

1. Identify a direct, indirect and overuse injury that may be included in the most common reasons for basketball hospitalisations shown in the following graph.

<table>
<thead>
<tr>
<th>Injury Type</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct</td>
<td></td>
</tr>
<tr>
<td>Indirect</td>
<td></td>
</tr>
<tr>
<td>Overuse</td>
<td></td>
</tr>
</tbody>
</table>

3 marks
According to the AIHW Australian sports injury hospitalisations 2011–12 report, all codes of football combined accounted for around one-third of all hospitalisations (34 per cent). The types of injuries sustained are outlined in the graph below.

a. From the graph, identify the most common type of injury sustained across all football codes. 1 mark
b. Classify the type of injury identified in part a. 1 mark
c. According to the graph, soft tissue injury is most common in which sport? 1 mark
d. State the types of soft tissue injuries that may occur in this sport and suggest a reason as to how these injuries might occur. 4 marks
e. Outline a preventative measure that could be used in all football codes that could reduce the incidence of soft tissue injuries. 2 marks

CHAPTER REVIEW

CHAPTER SUMMARY

Classification and types of sports injuries

Sports injuries can be classified as acute, chronic or overuse. Injuries can be sustained through direct contact, such as an external force, or indirect contact, such as an internal force.
Injuries occur to soft tissue such as skin, ligaments, tendons and muscles; and to hard tissue such as bones. Common types of injuries include cuts, abrasions, tears, strains, sprains, bruising, fractures and dislocations.

Measures can be taken to minimise the risk of injuries occurring in sport and to make the return to training as efficient as possible.

Musculoskeletal illnesses and conditions

Musculoskeletal conditions affect the bones, muscles, joints and ligaments of the body and often limit the capacity and mobility of an individual.

The most common illnesses and conditions in Australia affecting the musculoskeletal system include arthritis, osteoporosis and back pain.

Arthritis is characterised by inflammation around the joints, causing pain and stiffness. The most common forms are juvenile arthritis, osteoarthritis and rheumatoid arthritis.

Osteoporosis is characterised by the thinning and weakening of bone and is more common in women and people over 55 years of age.

Back pain can affect bones, joints, tissues and nerves of the back and often stems from overuse, injury, weakness, degeneration or postural misalignment.

Common preventative measures for musculoskeletal conditions include participation in regular physical activity, maintenance of healthy body weight, limiting sedentary behaviour and eating a nutritious diet.

Sports injury prevention

Sports injury prevention includes the following strategies: pre-participation screening; physical preparation of athletes; an appropriate warm-up and cool-down; use of protective equipment; correct footwear; taping and the use of braces.

The structure of training programs and the types of recovery techniques have a significant role to play in the prevention of sports injuries.

Protective equipment is most effective if it is worn during training and games, it fits correctly, it is specific and appropriate for the sport, size and age of the athlete and is regularly checked and maintained.

MULTIPLE CHOICE QUESTIONS

1. A muscle strain is an example of
   (A) an acute injury.
   (B) a chronic injury.
   (C) an overuse injury.
   (D) a direct injury.

2. Excessive movement of a joint is most likely to result in which type of injury?
   (A) Contusion
   (B) Laceration
   (C) Dislocation
   (D) Fracture

3. Which of the following is an example of an overuse injury?
   (A) Broken wrist
   (B) Shin splints
   (C) Concussion
   (D) Muscle sprain

4. The most common form of arthritis is
   (A) juvenile arthritis.
   (B) osteoarthritis.
   (C) rheumatoid arthritis.
   (D) osteoporosis.

5. Risk factors for developing osteoporosis include
   (A) sedentary behaviour.
   (B) poor calcium intake.
   (C) increasing age.
   (D) all of the above.

6. A common preventative measure against developing illnesses affecting the musculoskeletal system is
   (A) regular participation in physical activity.
   (B) consuming a diet high in calcium.
   (C) maintaining poor posture.
   (D) protecting your back when lifting heavy objects.

7. Which of the following is not an important consideration for the physiological preparation of an athlete in injury prevention?
   (A) Warm-up
   (B) Cool-down
   (C) Taping a joint
   (D) Appropriate fitness levels

8. The role of pre-participation screening is to
   (A) check your strengths and weaknesses.
   (B) determine medical history that could impact on physical activity.
   (C) improve your questionnaire skills.
   (D) see how fit you are.

9. A helmet is a preventative measure to reduce the risk of what type of injury to the head?
   (A) Contusion
   (B) Dislocation
   (C) Concussion
   (D) Sprain
10. Taping can assist in the prevention of injuries to a joint via
   (A) enhancing movement around a joint.
   (B) restricting movement around a joint.
   (C) stopping movement around a joint.
   (D) all of the above.

EXAM QUESTIONS

Question 1
The following graph outlines the body regions injured across a range of sports, for which hospitalisation was required in 2011-12.

<table>
<thead>
<tr>
<th>Body region injured</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>8000</td>
</tr>
<tr>
<td>Neck</td>
<td>2000</td>
</tr>
<tr>
<td>Trunk</td>
<td>6000</td>
</tr>
<tr>
<td>Shoulder &amp; upper arm</td>
<td>2000</td>
</tr>
<tr>
<td>Elbow &amp; forearm</td>
<td>10000</td>
</tr>
<tr>
<td>Wrist &amp; hand</td>
<td>10000</td>
</tr>
<tr>
<td>Hip &amp; thigh</td>
<td>6000</td>
</tr>
<tr>
<td>Knee &amp; lower leg</td>
<td>8000</td>
</tr>
<tr>
<td>Ankle &amp; foot</td>
<td>12000</td>
</tr>
<tr>
<td>Other and unspecified</td>
<td>12000</td>
</tr>
</tbody>
</table>

a. From the graph, identify the most common body region injured. 1 mark
b. Identify a direct, indirect and overuse injury that may occur to the body region identified in part a. 3 marks
   Direct: ____________________________
   Indirect: __________________________
   Overuse: ____________________________
c. Outline a preventative measure that could be used to reduce the likelihood of an injury occurring in the body region identified in part a. 2 marks

Question 2  (adapted from ACHPER Trial Exam 2014, section 1 and 2)
Identify and justify what type of injury would be most common in rugby and other contact sports. 2 marks

Question 3  (adapted from ACHPER Trial Exam 2014, section 1 and 2)
There are many arguments that highly physical sports such as rugby should separate junior competitions based on weight and not age. Discuss how this may lead to decreased injuries.

Question 4
Injuries to the knee and ankle are common in basketball. For each of the following areas, describe a preventative measure that could be implemented to reduce the number of knee or ankle injuries to the members of a basketball team:
a. training  b. equipment. 2 marks