**CHAPTER 3**

**PREVENTING MUSCULOSKELETAL INJURIES AND ILLNESSES**

**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

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**Osteoporosis**

**Arthritis**

**Common musculoskeletal conditions**

**Musculoskeletal injury and illness**

**Sporting injuries**

**Injury prevention**

**Acute**

**Chronic**

**Physiological**

**Physical aids**

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Source: Extracts from VCE Physical Education Study Design (2017–2021), reproduced by permission, © VCAA.
This chapter will initially focus on injury prevention and rehabilitation techniques in sport and physical activity before exploring some common musculoskeletal illnesses such as arthritis and osteoporosis.

Australia, like most Western countries, is being confronted with an ever-increasing rate of obesity and an associated increase in lifestyle diseases related to decreased activity, such as atherosclerosis, heart disease, stroke and type 2 diabetes. This is placing an overwhelming strain on our public healthcare system. Maintaining an acceptable level of physical activity has been clearly linked to a reduction in several risk factors associated with these lifestyle diseases, as well as helping to improve quality of life. These concepts will be explored further in chapter 13.

One approach to combating lifestyle inactivity has been to encourage increased participation in both sport and recreational pursuits. There have been numerous campaigns, strategies and policies implemented at all levels of government to support this strategy. This is an appropriate reaction to the alarming increase in lifestyle diseases. However, care also needs to be exercised to minimise the risk of injury (particularly serious injury) from sport and physical activity. According to a Victorian government sports injury prevention taskforce, ‘Sports-related injury is a major component of accidental injury in Victoria. It is second only to road traffic injuries in terms of years lost to disability and direct hospital costs. For children under 15 years, sports-related injuries now represent four times the public health burden when compared to road trauma related costs.’ Minimising the risk of injury will reduce the strain on the public healthcare system, and – perhaps more importantly – allow participants to benefit from a lifetime of enjoyment of their sporting pursuits.

Increasing participation in physical activity and sport across all segments of the population is a key policy objective of governments. However, participation in physical activity and sport will always carry a risk of acquiring activity-related injuries.

The immediate and long-term ‘cost’ of sports-related injuries results from:

» healthcare costs for treatment
» health system costs for insurance
» time and productivity lost to employment, school and home activities
» time lost to future sporting activities
» the cost of long-term physical, psychological or emotional damage
» equipment and program costs for rehabilitation and prevention.

However, the immediate and long-term ‘cost’ of inactivity, or insufficient physical activity to stimulate health benefits, also has an impact on individuals as well as on population-wide health and wellbeing.

**SPORTS INJURY CLASSIFICATION**

A simple, but effective, method of classifying sports injuries is based on how the injury occurred. Acute injuries occur suddenly and usually without warning – for example, a hamstring strain. Chronic injuries are usually associated with overuse of a particular area of the body over a period of time – ‘shin splints’ are an example.

Acute injuries can be further classified as either direct or indirect injuries.

**Acute direct injuries**

Direct injuries are the result of an external force and can be caused by:

» a collision with another person, either intentional or unintentional, such as being tackled or simply running into another person on a sporting field
» a direct blow from an implement such as a hockey stick, or being struck by a projectile such as a cricket ball.
These injuries may cause minor damage such as a bruise (haematoma), or major damage such as a broken bone.

**Acute indirect injuries**

**Indirect injuries** are usually caused by a sudden change in either direction or intensity, where the force required is greater than the load the muscle or ligament can sustain.

Ligaments are damaged when joints move further than the ideal physiological range (i.e. hyperextensions, subluxation, dislocation) or in a direction that is not the proper movement, such as a knee moving sideways.

When this damage occurs to a ligament, it is known as a sprain, and can be classified as either a grade 1, 2 or 3 sprain:

- A grade 1 sprain is defined as mild damage to a ligament.
- A grade 2 sprain is considered a partial tear of the ligament.
- A grade 3 sprain is a complete tear of the ligament.

Muscles are usually injured under eccentric loading or plyometric movements, as almost twice the force goes through a lengthening muscle as is used in a shortening concentric contraction. Eccentric contractions usually control movement, working against gravity or slowing down concentric movements.

Damage to a muscle, known as a strain, can also be classified according to severity:

- A grade 1 strain comprises damage to less than 5 per cent of muscle fibres.
- A grade 2 strain involves more extensive damage than a grade 1 strain, but the muscle is not completely ruptured.
- A grade 3 strain is a complete rupture of the muscle.

Indirect injuries can also be caused by simply losing balance and tripping over, resulting in minimal injury such as a bruise or major trauma such as a broken bone or loss of consciousness.
The immediate application of first aid to a sprained ligament or strained muscle can help to reduce recovery time. This should involve the cessation of the activity, followed by ‘RICER’.

A strained muscle; the result of an indirect injury

**QUICKVID**

Take a look at a short video by St John Ambulance on treating sprains and strains, if you are unsure of the procedure. You can link via http://vcepe12.nelsonnet.com.au.

**INVESTIGATION**

Investigate an acute strain injury, sustained during a sport of your choice. In your report include:
- a diagram and/or photo of the injury
- examples of elite sportspeople who have had the injury
- early warning signs of the injury
- possible cause[s] of the injury
- suggested strategies to treat the effects of injury, including surgery
- likely time frame before returning to sport
- suggested rehabilitation/recovery strategies
- an outline of preventative measures to avoid, or minimise, likely occurrence of the injury.

**Overuse injuries**

Overuse injuries result from the continual performance of some type of movement. They include shin splints from running and elbow tendonitis from tennis. A variety of factors can lead to overuse injuries, including:
SPORTS INJURY PREVALENCE

Collecting accurate statistical data about sports injuries is extremely difficult. An individual may slightly strain a muscle during a training session without this statistic being recorded. This is just one example of the difficulty in obtaining accurate information on sports injuries. Data is often cited from hospital statistics, yet the majority of sports injuries are never treated in a hospital.

In a study by Mitchell, Finch & Boufous (2010) more than 2000 sports participants in New South Wales completed a survey on sports injuries. Of those surveyed, 31 per cent had sustained some form of sports injury within a 12-month period. The two most common treatment methods were self-treatment (34 per cent) and physiotherapy (25 per cent).

INVESTIGATION

Investigate an overuse injury such as shin splints or osteitis pubis. In your report include:
- a diagram and/or photo of the injury
- examples of elite sportspeople who have had the injury
- early warning signs of the injury
- possible cause(s) of the injury
- suggested strategies to treat the effects of injury, including surgery
- likely time frame before returning to sport
- suggested rehabilitation/recovery strategies
- an outline of preventative measures to avoid, or minimise, likely occurrence of the injury.

SPRITNS INJURY PREVALENCE

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CHAPTER CHECK-UP

1. What is meant by the term ‘lifestyle disease’?
2. List three examples of lifestyle diseases.
3. Most athletes perform a warm-up before competing. Briefly discuss how this improves oxygen uptake when they start their activity and decreases oxygen deficits.
4. For a sport of your choice, list three possible:
   a. direct injuries
   b. indirect injuries.
5. Explain what happens within the body when a haematoma injury occurs.
Sports Medicine Australia

Sports Medicine Australia is Australia’s peak national umbrella body for the prevention of lifestyle diseases through sports medicine and sports science and injury prevention. Sports Medicine Australia is widely acknowledged internationally as the world’s leading multi-disciplinary sports medicine body.

Sports Medicine Australia, through its individual and organisational members, is Australia’s peak advisory body on all medical and health issues for active people at all stages of life, with a focus on prevention of chronic lifestyle diseases. The safe participation of Australians in sport and healthy physical activity to prevent obesity and lifestyle diseases associated with inactivity is the primary concern for all involved with Sports Medicine Australia.

Sports Medicine Australia can provide expert information, advice and commentary on a diverse range of issues. These range from government policy and funding for programs and activities which lead to the prevention of chronic diseases, sports medicine and community activity through to sports health, health promotion, gender equity, participation of the aged in sport, safe sport for children and drugs in sport problems.

Sports Medicine Australia plays an active role in educating professionals and community members about safe participation in sport, recreation and physical activity to create healthier outcomes to help control and combat preventable chronic disease.

Sports Medicine Australia draws together all sports medicine and sports science and population health professionals. These groups include:
- orthopedic surgeons
- physicians
- doctors
- physiotherapists
- population health specialists
- exercise physiologists
- dietitians
- academics
- sports scientists
- optometrists
- dentists
- podiatrists
- psychologists
- nurses
- teachers
- chiropractors.

At a community level, Sports Medicine Australia is responsible for creating a safe playing field in which all Australians can actively and freely participate, encouraging recreational and physical activity for the associated benefits of reducing preventable lifestyle diseases and educating community members about healthy lifestyle choices. The delivery of the Safer Sport message throughout Australia is achieved through the development and design of courses and educational resources for coaches, trainers, teachers and participants.

Sports Medicine Australia works to advance the health and activity of all Australians, and to support the continued professional development of persons interested in sports science, sports medicine and healthy activity.


Questions

Visit the Sports Medicine Australia (SMA) website.

1. Briefly outline the philosophy of SMA.
2. SMA has a range of programs for the community that promote physical activity through safe participation, e.g. Smartplay, Oz on the Move, Sports Injury Tracker, CleanEdge. Prepare a report outlining some of the information available about one of these programs.
3. SMA also has a range of policies relating to hot weather, infectious diseases, active children, active women, active older people, asthma management, concussion and dental injuries. Prepare an oral presentation (3–5 minutes) on one of these policies.

REAL WORLD APPLICATION

PHYSIOLOGICAL STRATEGIES TO PREVENT MUSCULOSKELETAL INJURIES

This section will look at the role of physiological strategies in preventing musculoskeletal injuries. It will discuss the importance of properly warming up, some important training methods in preventing musculoskeletal injuries, and the cool-down. But first, it is important to consider the relevance of pre-activity screening and the role it may play in minimising the risk of injury.
Pre-activity screening

The purpose of pre-activity screening is to minimise the risk of injury resulting from physical activity. Pre-activity screening is highly recommended for older adults and those with health concerns. In reality, anyone who is involved in, or intends to commence, any kind of physical activity should complete some form of pre-activity screening every 12 months. This may be part of a coach’s duty of care.

A common pre-activity screening is a Physical Activity Readiness Questionnaire (PAR-Q) for participants between the ages of 15 and 69 (see below). However, some conditions affect people younger than this age group; for example, Osgood-Schlatter disease of the knee. A reduced training volume is recommended for those with this condition. Without pre-activity screening this information would not be made available to the coach.

Regular physical activity is fun and healthy, and being more active is very safe for most people. However, some people should check with their doctor before undertaking regular physical activity.

If you are planning to increase your physical activity, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age and you are not used to being regularly active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly.

\[\text{PAR-Q \& YOU}\]

**A Questionnaire for People Aged 15 to 69**

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

**YES to one or more questions**

Talk with your doctor by phone or in person before you start becoming much more physically active. Before you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

**NO to all questions**

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- Start becoming much more physically active — begin slowly and build up gradually. This is the safest and easiest way to go.
- Take part in a fitness appraisal — this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

Please Note: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

**Physical Activity Readiness Questionnaire [PAR-Q]**

Source: Canadian Society for Exercise Physiology, 2002.
While not an exhaustive list, the pre-activity screening should provide information on:

» current health issues such as asthma and diabetes
» musculoskeletal conditions such as Osgood-Schlatter disease
» previous injuries that may impact on participation in some activities, such as a knee reconstruction
» information on current intake of any prescription medication
» family and personal medical history. (In some circumstances it may be more appropriate to obtain a separate medical history.)

If respondents to pre-activity screening such as the PAR-Q answered ‘no’ to all questions, and are not over the age of 69, a medical practitioner is not required to complete an evaluation of the participant.

There may be circumstances where a medical practitioner is required to complete pre-activity screening in order to clear a participant for a particular type of sporting activity. For example, in Victoria, the Professional Boxing and Combat Sports Board requires that participants have a medical clearance before they can register to compete.

**Warm-up**

A proper warm-up enables the performer to prepare both physiologically and psychologically for the main work to follow. From a psychological perspective, it enables the performer to focus on, and mentally prepare for, the upcoming work. It also enables the performer to increase their arousal.

A suitable warm-up usually lasts about 8 to 10 minutes and is characterised by an increase in core body temperature of 1 degree Celsius, or a slight sweat. The warm-up will commence with some light aerobic activity (for example, slow jogging) before gradually increasing in intensity. After 4 to 5 minutes of light aerobic activity, the warm-up should become more specific, as follows:

» If anaerobic type activities (such as speed work) are to follow, it would be appropriate to incorporate some stride-throughs.
» If weight training is to follow, the intended exercises should be performed with a significantly lighter load for the first two sets.
» If aerobic training is to follow, the performer could start to increase the intensity (after producing a slight sweat) until the required level is reached.

Below is an example of a general warm-up for a team-based running sport such as netball, hockey, soccer or Australian Rules football. For other activities such as cycling and swimming, the above suggestions could be modified to suit the intended activity.

» 4 – 5 minute jog
» 6 strides of 50 metres:
  - 2 @ 60%
  - 1 @ 70%
  - 1 @ 80%
  - 1 @ 90%
  - 1 @ 95%
» 2 × triggers
» Dynamic stretching if required
» No static stretching

There has been much debate about whether stretching should be included in a warm-up. There is no evidence to support the inclusion of static stretching, other than for the few sports that require participants to hold a static stretch as part of their performance. Static stretching may, in fact, be counterproductive. While the individual is performing static stretching (usually sitting down), the acute responses they have initiated in the warm-up (such as increased cardiac output and minute ventilation) will start to reverse.
Depending on the activity, it may be appropriate to incorporate some dynamic stretching specific to the activity about to follow. Dynamic stretching involves moving a joint through its range of motion with controlled momentum. This is ideal as part of a warm-up, and should mimic some of the movements about to be performed. A classic example of this is a footballer gently kicking his legs up to simulate kicking a football, or a swimmer rotating her arms at the shoulders to loosen up her upper body. Care needs to be taken to ensure that dynamic stretching does not turn into ballistic stretching, which involves the same movements as dynamic stretching performed with much greater force. This can be dangerous for most performers, as the increased momentum may lead to muscle strain. Ballistic stretching is appropriate only in very limited circumstances, such as ballet dancing, where the performers have spent years preparing their bodies for these types of movements.

Physical preparation

All training sessions will involve a conditioning component that may incorporate a variety of training methods such as continuous or interval training, resistance training, Pilates and core strength work. There is overwhelming evidence of the health benefits of being involved in physical activity. However, before looking at these training methods in more detail, it is important to consider the role of periodisation in any training program.

Periodisation is simply the structured planning of a training program. It ensures that progression is planned to avoid placing undue stress on the body. It also ensures that appropriate recovery is built into any training program to avoid the possibility of overtraining, which will dramatically increase the risk of injury. These concepts are explored in much greater detail in physical education Units 3 & 4. It is worth noting that any increase in the workload of a training program, known as overload, is carefully planned. Having easier weeks/training sessions every four to six weeks, known as unloading, is also critical in avoiding injury. It is important that training diaries are kept to record the details of training sessions as a point of reference for future planning.

Training methods to reduce the likelihood of musculoskeletal injuries include:

» strength training
» core training
» flexibility training.

Strength training

Strength training refers to a training method where a load is applied to a muscle or group of muscles. Generally this is achieved through weight training, either via free weights such as barbells and dumbbells or via machine-loaded resistance. Strength training can also simply involve a person’s own body weight, or the use of resistance bands.

Strength training is very effective for injury prevention as improvements in muscle and tendon strength help hold the body in proper alignment, particularly when moving or dealing with contact. Bone development is also enhanced through strength training.

Sport-specific training can also overdevelop specific muscle groups, causing an imbalance between groups. A carefully structured strength program can help overcome these imbalances, reducing the likelihood of injury.

Weight training

There are many weight-training programs and exercises. Some of these may actually increase the risk of injury. While research continues into the best sequencing, number of sets and repetitions, it is widely agreed that a properly constructed and individualised weight-training program will enhance sporting performance and help prevent injury.
Core training
Core strength is important in preventing injury. It can contribute to:
» improved running efficiency
» decreased risk of injury, particularly of the lower back
» improved transfer of power between the lower and upper body extremities, and vice versa (for example, a tennis serve will transfer power from the legs to the arms)
» improved balance.

TABLE 3.1 Weight-training terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
<th>Term</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitions</td>
<td>The number of times a weight will be lifted in a</td>
<td>Set</td>
<td>A group of repetitions performed without a rest</td>
</tr>
<tr>
<td>(reps)</td>
<td>sequence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load</td>
<td>The amount of weight to be lifted</td>
<td>Velocity</td>
<td>The speed at which the weight is lifted</td>
</tr>
<tr>
<td>1RM</td>
<td>The maximum weight that can be lifted in one</td>
<td>Novice or</td>
<td>Person with less than 6 months’ consistent</td>
</tr>
<tr>
<td></td>
<td>maximal exertion</td>
<td>beginner</td>
<td>weight-training experience</td>
</tr>
<tr>
<td>Multi-joint</td>
<td>Where two or more joints are involved, such as</td>
<td>Single-joint</td>
<td>Where only one joint is involved, such as a</td>
</tr>
<tr>
<td></td>
<td>a squat</td>
<td></td>
<td>biceps curl, which only uses the elbow joint</td>
</tr>
<tr>
<td>Isokinetic</td>
<td>The speed of the contraction is controlled</td>
<td>Isotonic</td>
<td>Concentric and eccentric phase</td>
</tr>
<tr>
<td>Isometric</td>
<td>A static contraction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Flexibility training
Improved flexibility will:
» improve sporting performance by enhancing speed, strength and power
» reduce the likelihood of injury, particularly for performers who need a full range of motion
» reduce the impact of delayed onset muscle soreness (DOMS).

Cool-down
For most sports, the best cool-down repeats the actions of the sport, but at a reduced intensity. This is active recovery. Active recovery helps a player return to pre-exercise levels.
A cool-down also helps reduce the effects of DOMS. This is the best time to perform stretching exercises, as the body is warm and will benefit from some flexibility exercises.

**Static stretching**

Static stretching occurs when a person stretches to a position and holds it for 10 seconds or more. An example of this is the seated hamstring stretch. There has been considerable research into static stretching; evidence suggests that it should not be performed during a warm-up preceding other activities as it may increase the risk of injury. This type of stretching is appropriate at the end of a training session or as an independent training method performed in isolation.
WHAT CAN GO WRONG IN TRAINING AND RECOVERY?

Inadequate pre-participation screening

Inadequate pre-participation screening and fitness assessments could result in trainers being unaware of medical conditions or an individual’s physical limitations. (See PAR-Q, on page 57, which is used for screening pre-participation.) Individuals commencing training may have a low level of physical conditioning, and may also have a low skill level. The entry point for the individual, along with assessment of their existing fitness level, must be factored in when designing a suitable training program, and sufficient provision should be made for recovery, to avoid training loads being set too high for the participant’s skill and fitness level.

Coaching conduct and practices

Some coaches may conduct themselves in an unprofessional manner, providing advice and implementing programs that are beyond their knowledge and qualification base. A coach whose qualifications and accreditation are not current could include unsuitable activities in training programs, such as the ‘hurdler’ stretch. If an injury occurs, unsafe coaching practices and unqualified people developing training programs or administering first aid, as well as poor immediate management procedures, could result in an injury becoming more serious.

Program design

Overtraining, sprains, strains and particularly back injuries can result from poorly designed training programs. Flaws in program design can include inappropriate application of training principles and inappropriate choices of training methods. Activities set up by coaches that are not in accordance with safety guidelines could also present a problem.

Activities and equipment

When designing a training program, careful consideration must be given to the participant’s age, size, body shape, sex, skill level and level of psychological and physical maturity. If a program is not tailored to individual participants’ capacities, needs and physical profiles, injury is more likely. Failing to develop skill levels or adequate core stability before competing could also result in injury or illness. Appropriate education about suitable warm-up, cool-down and stretching activities may not be provided to the participant, or they might be aware of appropriate strategies but choose not to undertake them when training.

Equipment can contribute to injury in training and recovery if:

» it is used incorrectly
» it is not cared for or maintained properly
» it is not used for the purposes for which it was designed
» safety dress codes are not observed during training and competition
» inspections of facilities and equipment are not regularly and routinely undertaken
» uneven and poorly maintained playing surfaces are not repaired.
**Insufficient recovery**

Training or competing without adequate recovery may expose an athlete to a greater risk of injury. It is during the recovery process that many important physiological responses occur. This enables a performer to approach the next competition or training session in a better physiological state.

Performing a functional assessment for a safe return to physical activity after rehabilitation is also important in reducing the risk of further injury.

**Environmental conditions**

Conducting training and competition during inclement weather without regard for the accepted guidelines, and thereby failing to implement prevention and treatment of environmental stress factors, could also result in injury or illness. Examples of inappropriate environmental conditions include storms, lightning, extreme heat, extreme cold or peak ultraviolet times. Training in poor environmental conditions, failing to provide adequate rest periods, fluid or shade, and lack of protection during training could also contribute to injury and illness.

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**CHAPTER CHECK-UP**

1. Why is pre-activity screening so important?
2. Outline two benefits of weight training.
3. Outline two benefits of core strength training.
4. Explain the importance of performing a warm-up.
5. What type of stretching should be performed during a warm-up? Justify your answer.

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**PHYSICAL AIDS THAT SUPPORT THE MUSCULOSKELETAL SYSTEM**

This section will explore the role of protective equipment, taping and braces in helping to minimise musculoskeletal injuries.

**Protective equipment**

Sport-specific protective equipment has been designed to help reduce, or prevent, musculoskeletal injuries. Some sporting organisations have made specific sporting equipment compulsory, such as a catcher’s helmet in softball, while in other organisations the use of protective equipment is optional, such as mouthguards in Australian Rules football.
Examples of protective sporting equipment range from the extensive protection worn by catchers in baseball and goalkeepers in hockey to a soccer player’s shin pads.

<table>
<thead>
<tr>
<th>Protective equipment</th>
<th>Purpose</th>
</tr>
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<tbody>
<tr>
<td>Mouthguards</td>
<td>Reduce cuts to the lips, mouth and tongue. Also help to protect teeth. Used in sports with a risk of head contact.</td>
</tr>
<tr>
<td>Helmets</td>
<td>Help to protect the brain from injury during impact. Also help protect the head from cuts in contact sports such as rugby.</td>
</tr>
<tr>
<td>Guards</td>
<td>Absorb impact, reducing the direct impact on a body part, such as knee pads worn when skateboarding</td>
</tr>
<tr>
<td>Appropriate footwear</td>
<td>Provides some protection from impact, as well as support for the foot and ankle</td>
</tr>
<tr>
<td>Eyewear</td>
<td>Reduces the impact of fast-moving objects such as a squash ball</td>
</tr>
<tr>
<td>Shin pads</td>
<td>Help to reduce injuries acquired in sports where there are fast-moving objects, such as hockey, and to protect against direct contact to the shin in sports such as soccer</td>
</tr>
<tr>
<td>Shoulder padding and body protectors</td>
<td>In heavy tackling sports such as rugby union and league, shoulder padding can help protect the top of the shoulder. Padded body protectors can help reduce the impact of fast-moving objects in sports such as cricket.</td>
</tr>
</tbody>
</table>
Taping and bracing
The main function of taping and bracing is to:
» provide joint stability during physical activity. The tape serves to restrict the amount of movement in a particular joint, commonly the ankle joint. This helps prevent ligament sprains. It is particularly beneficial in recovery from ligament sprains, as the tape can help strengthen the joint.
» provide stability for joints involved in landing, such as ankle taping for netball
» provide kinaesthetic feedback to the brain
» give individuals confidence that they are less likely to injure a joint, which is particularly important for those with a history of joint problems.

There are a variety of different taping methods used for different joints. To date, there is little scientific evidence of which is the ‘best’ method, though several websites make recommendations. You can find many reputable examples of taping on YouTube.

Bracing can offer greater joint stability, as the support provided by taping diminishes throughout the activity. Braces are also reusable. They are more commonly worn to support either the knee or ankle.

**PRACTICAL ACTIVITY**

**TAPPING**
Visit a reputable website to investigate taping techniques. Following the instructions on the website, attempt to tape a joint. You can link to the Elastoplast website via http://vcepe12.nelsonnet.com.au.

Bracing can offer greater joint stability, as the support provided by taping diminishes throughout the activity. Braces are also reusable. They are more commonly worn to support either the knee or ankle.

**CHAPTER CHECK-UP**

1. Outline two functions of taping.
2. Explain the difference between taping and bracing.
3. Provide two reasons why someone may choose to wear, or not to wear, optional protective equipment such as a mouthguard.
COMMON MUSCULOSKELETAL CONDITIONS

Musculoskeletal conditions are disorders of the bones, muscles and their attachments. They are the most common chronic conditions in Australia.

Common musculoskeletal conditions include:
- osteoporosis
- osteoarthritis
- rheumatoid arthritis
- back pain and other back problems.

According to Australia’s national agency for health and welfare statistics and information (AIHW), 28 per cent of Australians (more than 6 million people) have arthritis and other musculoskeletal conditions.

The most common musculoskeletal conditions affecting Australians
Source: Australian Institute of Health and Welfare. Licensed under CC BY 3.0 AU.

**Osteoporosis**

Osteoporosis is a disease that affects more than 1 million Australians. Osteoporosis literally means ‘bone with holes’, and it occurs when bones lose minerals such as calcium at a faster rate than they can be absorbed. As a result, the bones become less dense, losing strength and becoming more susceptible to breaks. Osteoporosis has no visible warning signs, and for sufferers of this disease the risk of future fractures increases with each new fracture.

Bone is made mostly of the protein collagen, as well as calcium and minerals that add strength to the bone. It is living tissue, so it is constantly being broken down and renewed. By about the age of 25 to 30, most people have usually achieved peak bone mass. Women are at an increased risk of osteoporosis after menopause, as drops in oestrogen levels reduce the uptake of calcium in bone formation.
The difference between healthy bone, and bone affected by osteoporosis

Source: Australian Institute of Health and Welfare. Licensed under CC BY 3.0 AU.

**QUICKVID**

Watch this seven-minute animation to gain a more detailed understanding of bone formation. You can link via http://vcepe12.nelsonnet.com.au.
Diagnosis of osteoporosis

Osteoporosis can be diagnosed by measuring a person’s bone mineral density. The ‘gold standard’ for this measurement is the technique known as dual-energy X-ray absorptiometry (DEXA). Results are compared to normative data.

Prevention of osteoporosis

Steps can be taken from an early age to prevent osteoporosis, including:
» ensuring an adequate intake of dietary calcium
» engaging in regular weight-bearing and strength-training activities. These encourage increased bone remodelling (see Table 3.3).
» ensuring sufficient vitamin D absorption, which assists in bone calcium uptake
» avoiding smoking.

**TABLE 3.3** Bone building (osteogenic) capacity of selected exercises

<table>
<thead>
<tr>
<th>Highly osteogenic</th>
<th>Moderately osteogenic</th>
<th>Low osteogenic</th>
<th>Non-osteogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basketball</td>
<td>Running</td>
<td>Leisure walking</td>
<td>Swimming*</td>
</tr>
<tr>
<td>Netball</td>
<td>Jogging</td>
<td>Lawn bowls</td>
<td>Cycling*</td>
</tr>
<tr>
<td>Aerobics</td>
<td>Resistance training</td>
<td>Yoga</td>
<td></td>
</tr>
<tr>
<td>Gymnastics</td>
<td>Brisk walking</td>
<td>Pilates</td>
<td></td>
</tr>
</tbody>
</table>

*Swimming and cycling have other health-related benefits, but not osteogenic benefits.

Adapted from Osteoporosis Australia

Arthritis

**Arthritis** is a disorder that involves inflammation in one or more joints. There are more than 100 different types of arthritis. Problems associated with arthritis include pain, stiffness and inflammation. Joint weakness may also be a symptom, limiting everyday basic tasks such as walking or driving. Arthritis is reported to be the major cause of disability and chronic pain in Australia, affecting nearly 4 million people.

The most common type of arthritis is osteoarthritis, a degenerative joint disease often caused by either trauma to, or infection of, one or more specific joints. Rheumatoid arthritis is another common form of arthritis, in which the body’s own immune system begins to attack body tissues.

**Osteoarthritis**

Cartilage is the smooth white tissue that covers the ends of bones, making it easier for them to slide over each other at joints with very little friction. In osteoarthritis this healthy cartilage starts to break down and wear away, allowing bones to rub together, causing swelling, reduced movement and pain. Initially pain is felt when undertaking activity that utilises the affected joint, but as the condition worsens pain may be felt even during rest. Typically, affected joints will become enlarged and tender, making it difficult to perform tasks involving the affected joint.
Factors that contribute to the onset and development of osteoarthritis include:
> joint injury or trauma (i.e. a dislocation or fracture)
> excess weight
> repetitive joint-loading tasks
> sedentary lifestyle.

**Rheumatoid arthritis**

Rheumatoid arthritis is a chronic disease causing inflammation of the joints, particularly the hands. It is classified as an autoimmune disease, but the causes of rheumatoid arthritis are not yet fully understood.

Normally our immune system functions to fight off infections. An autoimmune disease occurs when the immune system starts to attack the body’s healthy tissues instead. In rheumatoid arthritis the immune system attacks the synovial membrane (the lining of our joints), causing inflammation, pain and joint damage. In response to the inflammation, the joint then produces excessive synovial (lubricating) fluid, which results in unwanted tissue growth and bone erosion.
INVESTIGATION

BACK PROBLEMS
Back problems affect 14 per cent of Australians, or more than 3 million people. Investigate a back problem and write a report on your findings. In your report include:
• likely cause of the problem
• early warning signs of the problem
• strategies to alleviate or reduce the problem
• an outline of preventative measures to avoid, or minimise, the likely occurrence of the problem.

CHAPTER CHECK-UP

1 Outline the main components of bone.
2 What is osteoporosis?
3 Explain the cause of osteoarthritis.
4 Explain what an autoimmune disease is.
Increased participation in physical activity, which includes sport, is vital to help combat the increase in lifestyle diseases such as heart disease and type 2 diabetes.
Sports injuries are a major component of accidental injury in Victoria.
Injuries can be classified as either acute (immediate) or chronic (long-term).
Sprains occur when ligaments are stretched beyond their range, while a muscle tear is known as a strain.
To help minimise injuries related to physical activity and sport, pre-screening should occur to ensure the participant is ready to commence the activity.
Warming up and cooling down, including stretching, can help minimise the risk of sporting injuries.
Strength training, including core strength work, is an important consideration in reducing the risk of sports injuries.
Protective equipment and taping/bracing should be considered as a viable option to reduce the risk of sporting injury wherever possible.
The most common musculoskeletal conditions include back pain and associated problems, osteoporosis, osteoarthritis and rheumatoid arthritis.
Osteoporosis occurs when bone degradation exceeds bone regeneration.
Osteoarthritis is a degenerative bone disease.
Rheumatoid arthritis is an autoimmune disease.
### Multiple-choice questions

1. Lifestyle diseases are:
   - **A** diseases associated with what a person eats
   - **B** diseases associated with the way a person chooses to live
   - **C** diseases associated with the amount of physical activity a person is involved in
   - **D** diseases that are mainly genetic.

2. Overuse injuries are caused by:
   - **A** the repetitive nature of the activity
   - **B** insufficient recovery time between training sessions
   - **C** an inappropriate increase in training load
   - **D** all of the above.

3. Identify the correct statement:
   - **A** Bone is made mostly of minerals.
   - **B** Bone is living tissue.
   - **C** Males are more likely to suffer from osteoporosis than females.
   - **D** Vitamin D inhibits bone calcium uptake.

4. Steps that can be taken to avoid osteoporosis include:
   - **A** ensuring an adequate intake of dietary calcium
   - **B** avoiding smoking
   - **C** engaging in regular weight-bearing exercise
   - **D** all of the above.

5. Identify the correct statement:
   - **A** Cartilage makes it difficult for bones to slide over each other.
   - **B** Excess weight can contribute to the onset of osteoarthritis.
   - **C** Rheumatoid arthritis causes inflammation of the joints.
   - **D** There are three types of arthritis.

### Short-answer questions

6. What role does vitamin D play in bone formation?

7. There is often concern for astronauts who spend extended periods of time in zero gravity environments. Suggest one reason for this concern.

8. Outline two ‘costs’ associated with sports injuries.

9. Explain the difference between direct and indirect acute injuries, giving examples to illustrate your answer.

10. a. Expand the acronym RICER.
    b. Under what circumstances should RICER be applied?

11. Describe a suitable warm-up for a running-based team sport.

12. Outline one problem associated with performing static stretching during a warm-up.

13. Explain the difference between dynamic and ballistic stretching.

14. Present an argument for the inclusion of weight training in the training regime of a recreational sportsperson.