

# Recovery

A guide from the **sportscotland** institute of sport



*Providing high performance expertise  
to sport and athletes in Scotland*

sportscotland  
**institute** of sport  
high performance expertise

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For more info and to download an online version of this brochure please visit [www.sisport.com/recovery](http://www.sisport.com/recovery)

# Introduction

## Effective recovery from intense training is the difference between success and failure in sport

The **sports-scotland** institute of sport set up a multi-disciplinary working group to look at individual aspects of recovery for athletes, coaches and support staff. The working group is outlined on the back page.

- Recovery can be defined as the re-establishment of the initial state
- Recovery takes several forms – it could be the immediate compensation, restoring the deficit that the training produces and/or the longer term management of a training programme
- Recovery does not always need to be relaxation and can occasionally be tension. Sometimes it might just be a change of stress or reduction in tension. This recovery takes place through enhancement of activity (e.g. physical exercise), reduction of activity (e.g. sleep) or a change of activity (e.g. physically cross training or mentally relaxing with a book)
- Recovery needs to be individualised and involve more than one strategy. Recovery can be passive, active or pre-active but needs planning and is more than “not training”. It is an integral part of training
- Intelligent recovery improves performance

There is very little scientific evidence for specific recovery measures. Where there is science, there is controversy about what is being measured. This document is produced using a mixture of best practice and scientific evidence, if this exists to support this.

All athletes will be at different stages in their sporting journey and this resource should be used as appropriate for the individual and sport.

As with many areas of our work, advice of this kind is often open to healthy debate. We are certain that within this wide range of topics and detailed information, we provide some excellent resources as a guide for our readers.

A detailed report, with references and further reading, is available on each of the areas covered from the **sports-scotland** institute of sport on the website: [www.sisport.com/recovery](http://www.sisport.com/recovery)





# Periodising your training programme

## How does periodisation affect recovery?

When you train you are placing stress on the body's physiological systems. Training is the systematic and progressive increase in stress that you put your body under in order for it to become stronger, faster or fitter. Interestingly, it is during rest and recovery that repair and adaptation occurs. This process is called General Adaptation Syndrome (GAS) and was first proposed by Hans Selye (1956).

Periodisation in essence is how we plan your preparation for peak performance throughout competition. It is how coaches determine the quality and quantity of the training you do to avoid burn out or staleness and optimise your state of readiness for the competitive season.

A periodised plan underpins all of your training and recovery strategies allowing you to be physically, technically and mentally at your best for competition. This plan should be put together by yourself, your personal, technical and strength and conditioning coach; it is built around you being in the best possible shape (peaking) for priority events.

Your competitive year is often split into different phases. These usually include a pre-season (preparation), in-season (transition), competition (major events) and active recovery (rest) period. Your training cycles are split into macrocycles (1-4 years), mesocycles (months or blocks of months) and microcycles (usually your training week/weeks).

These are planned in advance to reflect the training year and/or your goals. Depending on which phase of the year you are in will be reflected in the levels of training you do.

The frequency of sessions (number in a week), the volume (how much overall work you do) and intensity (how hard you work) are fluctuated across the year to get the best blend of technical and conditioning work to minimise the occurrence of overtraining or staleness and allows you to train and compete to the best of your ability.

## KEY POINTS

- *Periodisation or fluctuation of volume and intensity, allows athletes to train hard at the correct times in the lead up to and throughout competition, whilst avoiding the possibility of overtraining*
- *Your programme is periodised to optimize performance for key competitions*
- *Recent research has indicated that several different forms of periodization can be used to manipulate frequency, volume and intensity. It is still unclear which method is best with most having a degree of applicability to a variety of sports*

# Flexibility & stretching

Flexibility requirements are individual to each sport with certain sports requiring a greater level of flexibility than others for optimum performance

Maintaining an adequate range of movement is important for both recovery and long term injury prevention. Muscle length imbalances can often translate into a loss of efficiency in movement and can consequently impact on performance.

## Self-release

Self-release is used to restore normal tissue length. A trigger point is a small painful knot in muscle tissue that can refer pain to other areas of the body. It can also affect a muscle by keeping it both tight and weak.

### Trigger point release:

- Directly stretches the trigger points in knotted muscle fibres
- Increases circulation that has been restricted by the contracted tissue

This can be achieved through the use of a foam roller, peanut (2 tennis balls taped together) or ball. It can be used before or after exercise.

## Stretching

### Dynamic stretching:

Dynamic stretching is implemented in the 'warm up' as it is used to replicate sport in that muscles are required to stretch at fast speeds in various body positions. Dynamic stretching:

- Improves 'active' flexibility through increasing the ability of the muscle fibres to be elastic
- Stimulates the central nervous system

### Static stretching:

Static stretching is performed **after exercise or separate to exercise**. One of the reasons for this is that static stretching may reduce force production, with the loss of voluntary strength and muscular power potentially lasting up to one hour after the static stretch. A static stretch should be held for 15-30 seconds and repeated a maximum of 3 times. Static stretching:

- Targets the muscle to relax
- Reduces blood flow to muscles
- Decreases the activity of central nervous system

### Partner stretching (PNF – proprioceptive neuromuscular facilitation):

PNF techniques involve a partner actively stretching the participant by some combination of altering contraction and relaxation of both agonist and antagonist muscles (i.e. Quadriceps/ Hamstrings). This should be utilised after exercise or separate to exercise.

## KEY POINTS

- Maintaining adequate range of movement is important for recovery and injury prevention
- Self-release targets trigger points to restore 'normal' tissue length
- Dynamic stretching is utilised in the 'warm-up'
- Static stretching is utilised after exercise or separate to exercise



# Cool down & active recovery

## Cool down

This is a group of exercises that are performed immediately after training or competition to provide a period of adjustment between exercise and rest.

### Aims:

- Improve muscular relaxation
- Remove waste products
- Reduce muscular soreness
- Return cardiovascular system back to rest

### Application:

- Activity/dynamic movement lighter than training level to bring cardiovascular responses down slowly
- Stretching to restore range of movement and reduce risk of injury when body temperature is still elevated



## Ice baths/Cold water immersion (CWI)

- Can improve your perceived feelings of fatigue
- Due to its pain-killer effects, may be particularly useful in high impact or contact sports
- Repeated exercise performance in the heat may be improved when a short period of CWI is applied during the recovery period
- Can be effective in reducing delayed onset muscle soreness (DOMS) after high intensity exercise while the effects on muscle recovery are less clear

### Application:

- Ensure that you trial ice baths prior to competition to ensure that they have a positive effect on you and your feelings of fatigue
- Ice baths may be better saved for competition recovery as there is evidence to suggest that regular use of ice baths (daily in a short period of time) may slow natural muscle recovery and so impair adaptation and performance rather than increase recovery
- There is little scientific rationale for what the lower limit of water temperature should be, and athlete tolerance or preference is often the basis

## Contrast baths

There is more evidence to suggest that alternative hot and cold might be better but this is practically very difficult to do sometimes.

- Increased circulation to the legs
- Increased circulation will speed up the rate at which metabolites that are produced during exercise are removed from the muscles
- Reduced lactate levels in the blood
- Increased perception of recovery

## Compression garments

The support and gentle compression effect of compression garments can assist athletes to recover faster and with fewer negative effects such as muscle soreness and lethargy.

Compression garments can be used during and after exercise, as well as during travel for the following benefits:

- **Reduce muscle fatigue** – during exercise muscles are exposed to vibration which causes muscle oscillation, resulting in muscle fatigue. Compression garments reduce muscle oscillation which in turn results in reduced muscle fatigue
- **Improve circulation** – graduated compression of the limbs actively encourages and increases venous return to the heart and lymph nodes. This results in faster warm up and enhanced overall circulation
- **Reduced muscle damage during exercise** – by reducing muscle damage, compression garments can minimise swelling post exercise and can significantly reduce the severity and duration of exercise-induced muscle injury and soreness
- **Reduced muscle soreness** – the graduated pressure works to improve the recovery cycle by helping the pumping action of the cardio vascular (CV) system; removing blood lactate from exercising muscles, leading to reduced swelling, faster muscle repair and reduction in muscle soreness
- **Deep vein thrombosis (DVT) protection** – DVT is a condition that mainly affects the lower body and is typically associated with long periods of travel or inactivity. Compression garments can enhance blood flow in these areas through enhanced venous return, reducing the risk of DVT and swelling in ankles and limbs

## Active recovery

Active recovery refers to low-intensity exercise following a competition or other intense workout.

These activities can all be completed at a very low level or can involve short bursts of activity (e.g. 5 secs) within low intensity work in between. Again trialling before a major competition is the best plan to find what suits you and best improves your perceived recovery levels.

Active recovery allows an athlete to physically and psychologically recover from the stresses of training and competing while still maintaining fitness levels.

Active recovery sessions encourage recovery by:

- Assists blood circulation
- Reduces muscle lactate levels
- Eases muscle soreness
- Positive effects on psychological recovery by improving relaxation

## KEY POINTS

- Cool downs restore the cardiovascular system back to rest
- Ice baths may be effective in high impact or contact sports in competitions
- Compression garments can assist athletes to recover faster and with fewer negative effects such as muscle soreness and lethargy
- Active recovery allows an athlete to physically and psychologically recover from the stresses of training and competing while still maintaining fitness levels

# Nutrition for optimal recovery

## Nutrition is a key component in enhancing adaptations to training and optimising performance

### Recovery strategies are sport and athlete specific:

- It depends on the intensity, duration and type of training undertaken as well as individual nutritional and performance goals
- For individual advice, see a performance/ sports nutritionist

Recovery begins after your last hard repetition or effort. It includes a range of nutrition-related processes:

- **Refuelling energy stores**
- **Repair and synthesis of muscle cells**
- **Rehydration**



### Refuelling

- Your recovery snack/meal should vary in size depending on the length, intensity and type of training. It should also be in line with your overall nutritional aims and how many sessions you are undertaking in a day
- Small, frequent meals and snacks allow you to meet your energy needs without the discomfort of overeating, particularly if you are training more than once a day
- Aim to have a snack/meal containing carbohydrate (CHO) as soon as you can after your activity has finished (ideally within 30 mins) as the body uses nutrients more efficiently during this time. This is particularly important if you undertake prolonged or high intensity training more than once a day
- When CHO needs are high due to the volume and intensity of training (e.g. endurance training), or you find it difficult to eat after exercise, go for compact forms of CHO e.g. low fibre choices of CHO-rich foods, sports drinks, milk shakes, fruit smoothies and liquid meal replacements
- For those with a restricted energy budget, manipulating snack/meal size, composition and timing can help you meet your nutritional goal

### Repair

- Consume some protein within a post-exercise recovery snack and/or meal to help repair muscle and improve muscle adaptations

### Hydration

- Try to drink regularly throughout the day
- After prolonged endurance and/or high intensity exercise, rehydration should be a priority as dehydration can have a negative effect on subsequent exercise sessions if not corrected before the next workout
- Alcohol can increase undesirable swelling to damaged tissues hindering repair processes. The advice is to avoid alcohol for at least 24 hours

### Other tips

- Be organised – have suitable foods and fluids available at your exercise venue
- Consuming suitable foods and fluid is more than adequate for optimal recovery from exercise (see suggestions in table below). Foods and fluids are preferable as they have a number of advantages compared to relying on commercial supplements

#### Examples of options which contain carbohydrate and protein to aid your recovery

Low fat milkshake

Bowl of cereal with milk

Meat or fish filled roll

Low fat yoghurt and a banana

Chicken, veg and pasta salad

Jacket potato with tuna sweetcorn

Liquid meal replacement

Scrambled/poached eggs and/or beans on toast

Crumpet with peanut butter

### KEY POINTS

- The amount you will need to eat and drink to aid recovery will depend on the type, intensity and duration of exercise as well as your overall nutritional goals
- Recovery snacks should contain some CHO and protein as well as some fluid
- Aim to have a recovery snack/meal ASAP after training, especially if you are training later the same day



## Why is psychological recovery important?

Psychological recovery focuses on the restoration of well-being and positive (or neutral) mood state in order to:

- minimise the chance of overtraining, illness and injury
- maximise training gains

Key to psychological recovery is developing a high level of self awareness. Only when you have developed a level of awareness that allows you to recognise your own emotional states will you be able to determine which activity (or strategy) can help you manage your mood and energy levels, thus facilitating the recovery process.

## Recognising emotions

The most effective way athletes can assess their emotional state is via regular use of a written, video or audio diary. By reflecting on how you react to specific emotional events that happen during competition or whilst training, you can learn to become aware of whether your subsequent reactions/behaviours are positive or negative. Over time, you will learn to establish the most effective coping strategies to adopt when experiencing any similar dysfunctional thoughts/emotions and subsequent behaviours.

In team or squad based sports, it is important that you develop the ability to not only assess your own emotions, but also those of your team-mates. An understanding of the best way to interact with other individuals, facilitates a supportive environment.

## Potential effects of psychological recovery

### Effective

- *Increases motivation*
- *Improves sense of well being*
- *Reduces training and life stress*
- *Enables you to feel rested*
- *Increases clarity of thoughts and positive thinking*

### Ineffective

- *Lowers motivation and apathy*
- *Increases level of stress/anxiety*
- *Increases chance of injury/illness & burnout*
- *Increases chance of symptoms of staleness/tiredness*
- *Increases ruminating (repeated) negative thoughts/worries*

## Best times for athletes to recover

Psychological recovery should be a fundamental part of your daily training programme, as it goes hand in hand with physiological recovery.

In fact, completing your warm down and your regular physical activities tends to have a psychological effect. In addition, below are some key times when you should closely monitor your thoughts/emotions and subsequent behaviours:

- In the days leading up to an important competitive event (at least 3 days before competing)
- In-between performances during an important competition (particularly when playing multiple matches over a short period of time)
- After all performances, particularly after extreme highs and lows
- During times of increased life stressors eg: when you have exams or work-related project deadlines to meet (the more stressful the life event/experience the more you will need to monitor your psychological recovery)
- As soon as possible after your last performance (see timeline below)

### Within the first hour

*Carry out your individual performance review/debrief, if possible. Relax as appropriate (e.g. read, take in a movie, socialise).*

### Post first hour

*Use relaxation skills to switch off. Start to individually unwind, use music if appropriate (particularly important if training or competing at night, as you need to cool down mentally as well as physically).*

### Prior to bed sleep optimisation

*Have a specific set time to access social support groups. Follow personalised sleep guidelines.*

## Some key strategies to aid recovery

- **Listen to music**  
Use music to elicit changes in mood states eg: if over anxious use relaxing music
- **Debrief performances**  
Ensures that there is closure and disengagement from performance
- **Emotional recovery**  
Use of simple distracters that are non-sport related
- **Contingency planning**  
Developing solutions to "what if's" in post-performance scenarios
- **Access social support**  
Know who and when to access significant supportive others
- **Relaxation techniques**  
Exercises designed to energise and regulate levels of anxiety/arousal

For more information on the above recovery strategies go to our website: [www.sisport.com](http://www.sisport.com)





# Massage

## There is a long history of using massage to aid recovery in high performance sport

Its main purpose is to assist in reducing residual training fatigue and stress so that you start a new training session in as fresh a state as possible. It can also be helpful in a preventative way, by reducing localised muscle tension that can, with time, lead to an overuse type injury. There are times, such as following competition, heavy training periods or travel, when massage can be particularly helpful.

The complex mechanisms by which massage impacts on the recovery process have still to be fully researched and understood, particularly the physiological ones. There is evidence of massage leading to improved mood states and feelings of well-being that help physical and psychological relaxation and recovery.

### Some specific benefits of massage are:

- Decreased sensations of fatigue and muscle soreness
- Calming the nervous system
- Encouraging effective sleep
- Reducing muscle tension and normalising muscle tone
- Identifying soft tissue under stress and potential trouble areas

### KEY POINTS

- *The appropriate technique for the circumstance is vital*
- *Prior approval has to be obtained for massage*
- *Keep note of what timing delay works best for you in your different training and competition phases*

The types of massage techniques delivered will vary depending on whether the athlete is in training or competition as wrongly applied massage can interfere with performance during competition.

It is important to use approved **sportscotland** institute of sport network massage practitioners who are experienced in sports massage and are able to apply the appropriate type of massage in different training or competition phases.

Sports massage must be authorised by the physiotherapist whose care you are under within your sport or current treatment strategy.

# Sleep

## How can sleep help recovery?

Good quality and quantity of sleep is thought by many experts of different professions as being essential to achieving good recovery.

The quantity may vary from individual to individual but athletes should be achieving a minimum of seven hours and possibly aiming for eight hours.

The perfect amount of sleep for an individual is based on how long they sleep when they are healthy and wake up spontaneously (i.e. without an alarm clock or other stimulus). They should feel refreshed and awake.

Sleep disturbance in an athlete who has previously been a good sleeper should be brought to the attention of your support team.

Inadequate sleep accumulates as sleep loss leading to a tendency to fall asleep during the day and may cause a reduction in performance. This is recorded by the brain as debt which can only be reduced by more sleep.

Studies have shown that extra sleep does not cause sluggish performance but that immediately after waking there is a period of about 90 minutes when sleep inertia (a feeling of sluggishness and reduced performance) occurs.

This is important when napping in the afternoon and then performing, a clear 90 minutes should be left between sleep and performance.

Naps should be less than 30 minutes; power naps lasting approx 20 minutes can be useful as they allow a refreshing sleep. This does not allow the brain to have a deep sleep which could, on waking, lead to sleep inertia and poor performance. The effects of sleep inertia can be modified by showering, caffeine, bright lights and light exercise.

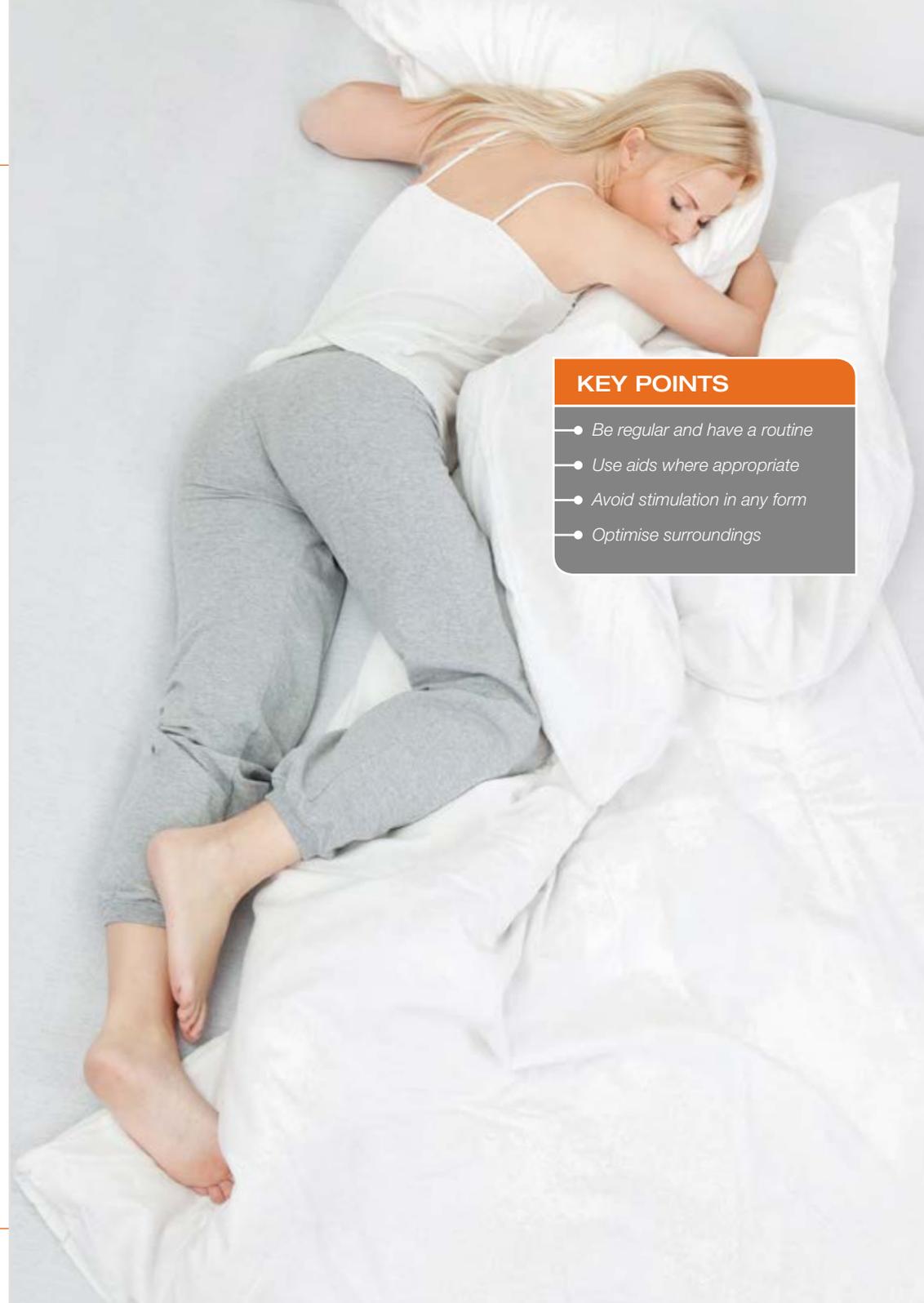
A high performance athlete should understand and assess their sleep quantity and quality as regularly as possible by using a monitoring questionnaire or as an integral part of a diary.

## Guidelines for quality sleep

- Be regular in routine as sleep is a habit which is trainable
- Where possible use the bedroom for sleep only and do not watch TV, play computer games or read. The mind will then associate the bedroom with sleep and thus retiring to the bedroom will send a message to the sleep inducing areas of the brain
- Use night shades and ear plugs where appropriate
- While light reading prior to bedtime can be helpful it should take place in another room, if possible
- Avoid computer games and TV programmes with marked screen activity as these stimulate the brain
- Avoid stimulants in late evening such as coffee, stimulant soft drinks and large doses or quantities of alcohol
- Similarly, while exercise is helpful to sleep it should ideally take place in the early evening to allow its arousal effect to subside prior to bed time
- Avoid big meals for 3 hours prior to bed but light carbohydrate snacks and a warm drink e.g. milk may be helpful
- A warm bath may help but if too hot too close to bedtime may be counter-productive
- Have subdued lighting in bedroom and a comfortable temperature neither too hot nor too cold, making sure extremities are warm

### KEY POINTS

- Be regular and have a routine
- Use aids where appropriate
- Avoid stimulation in any form
- Optimise surroundings



# Athlete health and wellbeing

## Fundamental to performance and recovery is the ability to successfully monitor and manage ongoing health and wellbeing

### Recovery from injury and illness

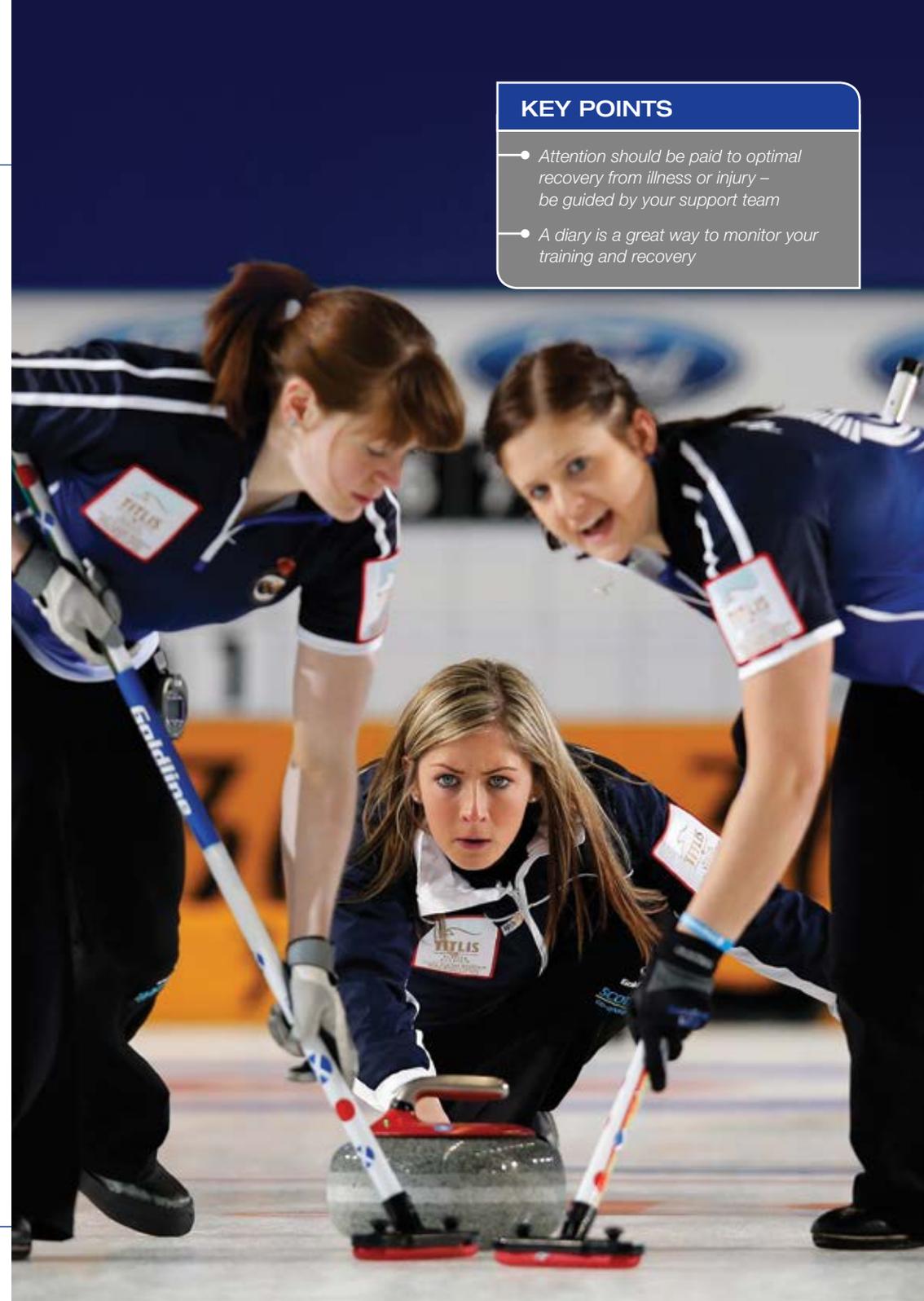
- Be guided by the professionals
- Be compliant to your rehabilitation plan
- Be aware of the impact of other activities on your injury and recovery
- Gradual increase in load is essential – as determined by support staff
- Optimal recovery may require nutritional advice, lifestyle management and, where possible, appropriate psychological support

### Athlete diary management

- A performance diary allows you to track performance and recovery, aiding you in long term planning and gaining best performances
- A good performance diary includes the following measures:
  - Full details of training and competition volume, intensity and time
  - Monitoring of physiological markers i.e. waking heart rate
  - Perceived level of fatigue
  - Any specific recovery strategies implemented
  - Assessment of mood (5 mood states VG, G, OK, B, VB)
  - Sleep quantity and quality
  - Assessment of life factors – personal, family, work, study and any other source of stress
  - Record health and injury status i.e. I've got a niggle in my hamstring
- To rate and measure the different elements – we recommend that the scale of 1 – 5 is used
- A member of the support team should ideally be monitoring the performance diary needs to identify patterns of markers and behaviours

### KEY POINTS

- Attention should be paid to optimal recovery from illness or injury – be guided by your support team
- A diary is a great way to monitor your training and recovery



## How does managing your lifestyle affect your recovery?

Strategies for recovery include different scientific approaches – lifestyle management has an impact on recovery by pulling together this advice and developing a lifestyle that is conducive to performance. From research, we know that when you learn to manage the distractions that get in the way of your performance – lifestyle management can have a positive impact on recovery.

If you are training, competing and managing a performance-based lifestyle then you will have to contend with a variety of distractions.

Similarly, as you develop and progress, more and more demands are placed on your time by an increasing number of people – including coaches, support staff, employers/educators, family and friends. In the middle of all of this – you need to ensure that you can prioritise recovery from training and competition, in both passive and active ways.

These distractions can have both a positive effect and a negative effect – depending on the individual, their circumstances and their stage of development.

Research into training motivation in elite rugby players (McCarroll and Hodge 2004) revealed that players who had good time management, organisational skills and had an integrated lifestyle (i.e. they had some other interest outside rugby), were those players who adhered to their programmes; had high levels of training motivation, were able to manage the distractions around them and, as a result, were able to successfully perform at the highest level and sustain their performance over time.

### Key points

**Performance Lifestyle™** if you have access to this service, use your local PL Adviser.

**Use a diary** to prepare and plan; to prioritise your time; monitor your training, performance and recovery. Plan for recovery! It is as important as training and needs to be built into your periodised plan.

**Monitor and manage your health and wellbeing** on an ongoing basis and make decisions that suit you as an individual. This includes the physical, cognitive, emotional and social aspects of your life.

**Distractions** need to be identified and relevant to you as an individual. Distractions can be positive or negative – depending on the individual and circumstances. Finding the solutions to help manage distractions makes a significant difference in your ability to be independent, plan, rest and recover. These factors can assist your performance and support the longevity of performance.

#### Negative distractions

*Work or no work*

*Study and exams*

*Nothing to do but your sport*

*Funding and finance*

*Impact of travel*

*Time – not enough*

*Boredom*

*Injury*

*Demands of others on your time*

#### Positive distractions

*Recover – actively and passively*

*Do something away from sport*

*Mental stimulation – challenge yourself*

*Mental relaxation – your own space to unwind*

*Try new challenges – do something different*

*Personal development*

*Individualise travel strategies*

*Manage your time – plan, prepare, prioritise and organise*

*Integrate all elements of your life into your planning*

**Transition tolerance** identifies key athlete development stages in your sport and plans for the transition phases i.e. when you move from junior to senior level of competition.

**Plan** a lifestyle that is conducive to performance by:

- Using a periodised plan and diary
- Eating to fuel and refuel
- Drinking fluids to hydrate and rehydrate
- Ensuring quality sleep
- Adopting psychological strategies that facilitate recovery and discuss individualised recovery strategies with your support team



## Medications

At this moment in time there is no evidence in support of using medication in recovery strategies other than using analgesics e.g. paracetamol for pain relief. There is increasing evidence that use of non-steroidal anti-inflammatory drugs (NSAIDS e.g. Ibuprofen) are unhelpful in immediate post-injury situation as it may interfere with the healing process.

In the future there may be a possible role for melatonin in jetlag management but at this moment in time the evidence is not strong enough for safe recommendation.

It is important that athletes remember that if they have taken morphine as a pain killer then a therapeutic usage exemption certificate must be completed.

Some herbal remedies may also include ingredients that could result in a positive doping test.

It is also important that all athletes record all medications and supplements taken in the week prior to a doping test on the dope test form when they are completing it.

For information on medications and anti-doping regulations go to [www.globaldro.com](http://www.globaldro.com)



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