# Nutrition for optimal recovery

### Introduction

Recovery is one of the most important factors in enhancing adaptations to training and optimising performance. It encompasses a range of nutrition-related processes including:

- Refuelling of glycogen stores
- Repair and synthesis of muscle cells from available protein pool
- Rehydration

A comprehensive review of the scientific literature on each of these processes enables us to identify a number of dietary strategies that can promote rapid and effective recovery following key training and competition sessions. These strategies have been integrated into guidelines for Recovery Nutrition.

## Recovery from key training or competition sessions based on endurance or 'quality' work

### Guidelines for athletes that are training once per day:

If an athlete has 24 hours or more recovery between sessions, then as long as total carbohydrate required to replete glycogen is achieved within the recovery period the timing is less important. Athletes should be encouraged to seek advice from a sports nutritionist to assess the quantity and quality of carbohydrate required.

**Guidelines for athletes that are training twice per day:**

When there is less than eight hours between workouts or events that deplete glycogen stores (stores may be depleted when exercising for 90minutes or more of high intensity work), the athlete should maximise effective recovery time by consuming a high carbohydrate (CHO) meal or snack within 30 minutes of completing each session.

Effective refuelling should begin after the last hard effort in training.

High glycemic index foods in the immediate recovery period are advised when recovery periods are short (see table 1).

Aim for at least 1 g of CHO per kg BM immediately after exercise, and repeat every 2 hours until normal meal patterns are resumed (see Tables 1 and 2).

Recovery snacks and meals should contribute towards a daily CHO intake of 7-12 g per kg BM. Total CHO requirements need to be individualised to each athlete's exercise program and energy budget (see Section C for special comments for athletes with a restricted energy budget

CHO is the priority after prolonged aerobic exercise. Most evidence suggests that the presence of protein does not appear to effect the level of glycogen when CHO is at the threshold level of glycogen resynthesis. (Van Loon et al, 2000 & Ivy et al, 2002) However if an athletes energy intake does allow them to consume sufficient CHO then adding protein in the immediate meal & snack may help (either through increased response from protein or as result of increased energy). However the consumption of protein within recovery snacks and meals helps to enhance the synthesis of new proteins underpinning adaptations to the workout as well as contribute to any increase in protein requirements related to exercise. Therefore as long as protein does not displace CHO, protein combined with CHO within 1 hour post exercise is advisable.

When CHO needs are high, and appetite is suppressed or gastric comfort is an issue, the athlete should focus on compact forms of CHO, including low-fibre choices of CHO-rich foods, sugar-rich foods, sports drinks, milk shakes, fruit smoothies and liquid meal replacements. Small, frequent meals may assist the athlete to achieve high CHO intakes without the discomfort of overeating.

When gastric comfort or total energy requirements limit total food intake, high fat foods and excessive amounts of protein foods should not be consumed at the expense of CHO choices. (See Section C)

Nutritious CHO foods and drinks contain other nutrients including vitamins and minerals that may be important in other post-exercise recovery processes. These nutrients are also important in the overall diet. Future research may show that intake early after exercise could enhance other activities of repair and rebuilding, as well as the immune system.

For endurance athletes it may also be important that they have sufficient fat in their overall diets to replace intramuscular stores of fat.

The athlete should avoid excessive intake of alcohol during the recovery from exercise. Although there is potential for direct effects on refuelling and recovery processes, alcohol exerts its main effect on recovery through indirect means: the intoxicated athlete is unlikely to follow sound nutritional practices and is more likely to undertake high-risk behaviour and suffer an increased risk of accidents.

Alcohol is a powerful vasodilator of cutaneous blood vessels, therefore if any muscle damage/soft tissue injuries have occurred it has been suggested that alcohol could increase undesirable swelling to damaged sites and therefore might hinder repair processes. The advice would be to avoid alcohol for at least 24 hours.

It is important to note that athletes that are dehydrated will be compromised in their ability to refuel. This should be taken into consideration when planning a recovery strategy to ensure rehydration requirements are also addressed. (See section D)

## Recovery from key resistance training workouts

### Guidelines for pre-exercise recovery strategies

The athlete should consume a source of at least 40g CHO & 6g of essential amino acids prior to the session (equivalent to 10-20 g of a high quality protein). This has been shown to promote enhanced protein recovery after the workout (Tipon et al, 2000).

### Guidelines for post-exercise recovery strategies

The athlete should repeat the pre exercise recovery strategy above & consume at least 40g of CHO & 6g of essential amino acids within the hour after the session (CHO consumed at the same time may enhance the protein response and promote rapid recovery of muscle glycogen stores). Table 2 provides suggestions of protein/CHO snacks and light meals that can be consumed to promote recovery until normal meal patterns are resumed.

When strength-training sessions are prolonged, or undertaken in conjunction with an aerobic exercise session, the athlete should undertake strategies to promote rapid recovery of depleted muscle glycogen stores. Athletes should aim to consume 1gram CHO per kg BM and 10 to 20grams of high quality protein. These issues are discussed in more detail in Section A: Guidelines for recovery from an endurance workout.

The athlete should avoid alcohol during the hours following a strength workout, since there is evidence that alcohol impairs protein synthesis.

The athlete's daily diet should provide adequate total energy and protein intake to meet their goals for gain of muscle mass. In terms of daily protein requirements, the maximum intake that is likely to be needed is ~ 1.5-2.0 g per kg BM. Research to date does not support intakes above this level, and intakes greater than this are not likely to confer any additional benefits for muscle gain.

It should be noted that when muscle hypertrophy is main goal then it is critical that an adequate overall energy intake is consumed for an anabolic response on a day to day basis.

## Special comments for the athletes with a restricted energy budget

Pre- or post-exercise recovery snacks should not contribute additional energy to a restricted energy budget. Rather, when rapid recovery is desirable, the energy-restricted athlete should change the timing of their existing meal structure to allow for immediate intake after exercise sessions. One option is to reschedule training sessions or meals so that the athlete is able to eat their normal meal as soon as possible after the workout. Where this is not practical, the athlete may be able to take a small snack from within their usual meal plan to consume immediately after training or as a pre-resistance training snack (for example, fruit and flavoured yoghurt usually consumed as a dessert with dinner), then consume the remainder of their meal at the usual time.

Since the athlete may have increased requirements for protein and micronutrients as a result of their exercise program, it is important that foods consumed as recovery snacks contribute to overall nutrient intake goals as well as immediate recovery needs. Nutrient-rich CHO foods and drinks (e.g. fruit, flavoured milk drinks and dairy foods, sandwiches with meat and salad fillings) are more valuable than lower nutrient choices (e.g. lollies, soft drink, bread with jam or honey).

The energy-restricted athlete should also make use of foods with a high fibre content (e.g. fresh fruit rather than juice), high volume/low energy density (e.g. salad fillings added to sandwiches) or low GI (e.g. rolled oat cereals rather than cornflakes) to maximise the satiety value of meals and snacks. The addition of protein to meals and snacks (e.g. yoghurt with fruit, meat or cheese in sandwich) also improves satiety. Guidelines for low-fat eating are also important.

The energy-restricted athlete is unlikely to have a sufficient energy budget to cover the guidelines for optimal intakes of some macronutrients (e.g. CHO for optimal daily glycogen synthesis). Specialised dietary advice from a sports nutritionist is valuable in ensuring that the athlete has reasonable goals related to their energy requirements and physique goals, and is able to organise meal plans to optimise their nutrient intake within this energy budget. It may be valuable to cycle between nutritional goals – i.e. restrict energy during periods suitable for loss of body fat, while liberalising energy and CHO intake to promote better fuelling and recovery for key sessions or competition.

## Hydration

Dehydration will have a negative effect on subsequent exercise sessions if not fully corrected before the next workout. However, moderate to severe fluid deficits can also have an effect on recovery, since they are associated with an increased risk of gastro-intestinal upset and discomfort, potentially limiting the athlete's ability to ingest substantial amounts of nutrients. Therefore, rehydration should be considered an immediate priority, especially where gastrointestinal function is compromised. Early recovery strategies may need to focus on rehydration goals (e.g. consuming dilute fluids) before the athlete is able to consume significant amounts of the macronutrients needed for refuelling and protein recovery.

The athlete should not rely on thirst or opportunity to dictate fluid intake to reverse a situation of dehydration. A random approach may be acceptable when fluid deficits are 1 L or less, but when fluid losses are greater, an organised schedule is required.

The athlete should monitor changes in body mass from pre- to post exercise to evaluate the success of drinking strategies during exercise, and the residual fluid deficit that must now be replaced. A loss of 1kg is equivalent to 1 litre of fluid. Since fluid losses will continue during the recovery period via urine losses and ongoing sweating, the athlete will need to consume additional fluid to counter this. Typically, a volume equal to ~ 150% of the post-exercise fluid deficit should be consumed over the subsequent 2-4 hours to fully restore fluid balance.

Typically, a volume equal to ~1.5x fluid lost should be consumed over the subsequent 2-4hrs to fully restore fluid balance. Fluid loss is equal to weight pre-exercise(g) minus weight post-exercise (g) plus any fluid consumed during exercise (ml) minus urine losses (g)'.

It is important to ensure that an adequate supply of palatable drinks is available. This may be challenging and forward planning is the key to success.

In situations where fluid intake needs to be encouraged, the provision of flavoured drinks is a useful strategy. Since most people prefer sweet tasting drinks, they are likely to increase their voluntary intake of such fluids. Keeping drinks at a refreshing temperature is also known to encourage greater intake. Cool drinks (10-15 $^{o}$C) are preferred in most situations. Very cold fluids (0-5 $^{o}$C) may seem ideal when the environment or the athlete is hot; however it is often challenging to drink them quickly or in large volumes.

Carbohydrate-containing drinks are also useful in assisting with refuelling goals and allow the athlete to tackle a number of recovery goals simultaneously.

In the situation of moderate-large fluid deficits (e.g. > 2 L), sodium replacement will assist the retention of ingested fluids, by minimising urine losses. Options include sports drinks, commercial Oral Rehydration Solutions, salty foods or salt added to post-exercise meals. A high sodium beverage such as an Oral Hydration Solution (50-90 mmol/L or 2-5 g of salt per L), or salt added to post-exercise meals along with substantial fluid intake should guarantee that sufficient fluid and sodium have been replaced.

Electrolyte-containing drinks (e.g. Sports drinks containing electrolytes) are the preferred option for recovery when exercising in hot or humid environments or for heavy sweaters as they replace the electrolytes lost in sweat – water cannot do this.

Athletes are often educated that the production of "copious amounts of clear urine" is a desirable state and a sign of good hydration status. Measurements of urinary specific gravity or osmolality are sometimes undertaken to provide an indicator of euhydration and good hydration practices. Although this may be true in the long-term situation, the athlete is reminded that during the acute period of fluid replacement immediately following dehydration, mismatch of fluid and electrolyte replacement can lead to production of large amounts of dilute urine despite the continuing existence of substantial fluid deficits. Thus, in the case of significant fluid loss, the athlete should be aware of the need for electrolyte replacement, and should know that "urine checks" over the first hours of fluid intake often provide false readings.

Dietary strategies that minimise urine losses during the rehydration period not only enhance the speed of regaining fluid balance, but help the athlete to achieve better quality rest or sleep without frequent disturbances related to having to get up to urinate.

Whilst hydration is important in the recovery process consuming fluids in excess of the recommendations (particularly if that fluid is water) can be detrimental to your health.

Caffeine-containing fluids (e.g. cola drinks, tea, coffee and energy drinks) are generally not considered to be ideal rehydration beverages since caffeine may increase urine losses. It is often suggested that alternative choices should be used for early post-exercise rehydration, and that once fluid balance has been substantially restored, the athlete may have greater freedom in making drink choices. It should be noted that a recent review of the caffeine literature concluded that the diuretic effect of caffeine is overstated in habitual caffeine drinkers. Furthermore, greater voluntary consumption of favourite beverages such as Cola drinks may lead to better hydration status even if they are associated with a slightly greater urine production. Although in practise "fizzy drink" are not usually advised due to reasons such as energy budgets, gastric discomfort &/or dental hygiene.

Alcohol also causes an increase in urine losses, and drinks containing significant amounts of alcohol (4% or more of volume) are not considered ideal rehydration beverages. Nevertheless, athletes are reminded that alcohol exerts its main effect on recovery through indirect means: the intoxicated athlete is unlikely to follow sound nutritional practices and is more likely to undertake high-risk behaviour and suffer an increased risk of accidents.

Where possible, the athlete should avoid post-exercise activities that exacerbate sweat losses – for example, long exposure to hot-spas, saunas or sun.

## Summary

Adequate nutritional recovery strategies can impact on an athlete's performance, particularly when recovery time between session or competition is short. Providing adequate nutrients to replenish those lost, enhance repair and adaptation, not only improve the recovery process but will improve the athletes' general well being, confidence and sleep patterns. Recovery should be viewed by athletes and coaches as a continuation of the training session, which should be planned, reviewed and adapted as necessary for an individual. Recovery is an important piece of the performance jigsaw which should not be overlooked.

## General guidelines

Aim to consume 1 g CHO per kg BM combined with some protein straight after a session.

Aim to consume 10-20 g of a high quality protein combined with CHO within one hour after resistance workouts.

Replace fluid losses with ~ 150% of that lost. Fluid replacement options may include dilute fluids such as squash or fruit juice and water combinations. Hypotonic or isotonic electrolyte sports drinks may also be used but excessive intakes of sports drinks should be discouraged without a nutrition assessment by a sports nutritionist.

Avoid alcohol for 24hours during the recovery period.

**The above are general recovery guidelines, you should request a consultation with a Sports Nutritionist about specific individualised guidelines to optimise your recovery.**

## Carbohydrate recovery snacks and light meals

Each of the following selections in Table 1 and Table 2 provide between 40 -70g of carbohydrate (CHO). The athlete should use this guide to consume at least 1 g CHO per kilogram of their body mass (BM), to ensure speedy recovery of glycogen stores (post-exercise recovery) or to "top up" fuel stores prior to a workout (pre-exercise snack). In the case of post-exercise recovery, this strategy should be repeated after one-two hours or until normal eating patterns have been resumed. The intake of protein (10-20 g) in conjunction with CHO will help to meet goals for enhanced net protein synthesis.

Table 1 is for use when athletes have 8 hours or less between training sessions or during competition or training when glycogen stores have been challenged. The foods in table 1 should be followed up with a meal or further snack within 2 hours. If total body weight is an issue then a sports nutritionist should be consulted to ensure most appropriate snacks are chosen.

**Table 1:**
**High Glycemic Index Carbohydrate snacks that contain approximately 50g**

| |
|---|
| **800 -1000 ml sports drink |
| **800 ml High Juice |
| **500 ml fruit juice, soft drink |
| **60-70 g jelly beans or jelly babies (approx 10 sweets) |
| **Jaffa cakes (5) |
| **2 sports gels (check label for total carbohydrate content) |
| 1 round thick-sliced sandwich/bagel jam or honey |
| 250 g (large) baked potato or mashed potato |
| 100 g pancakes (1-2 large) + 30 g syrup or honey or jam |
| English Muffins x2 with syrup or honey or Jam |
| Medium bowl of cornflakes/weetabix/ branflakes/rice krispies |
| Ripe Banana & large tablespoon of raisins (30g) |
| **75g Turkish Delight (no chocolate cover) |
| 200g tinned fruit & 200ml of fruit flavoured yoghurt |

**Please remember if using very sugary foods for recovery on a regular basis then ensure extra care with dental hygiene

**Table 2:**
**Foods are suitable before & after strength training when an athlete is looking to enhance net protein synthesis:**

| Food | Portion | Carbohydrate | Protein |
|---|---|---|---|
| Liquid Meal Replacement & fresh or dried fruit | 250ml & portion of fruit | 50g | 14 |
| Liquid Meal Replacement & a banana | 250ml & medium banana | 58g | 15 |
| Friji Fresh Thick Flavoured Milk Shake | 500ml | 57 | 17.5 |
| Yop Drinking Yoghurt | 400ml | 57 | 18 |
| Large Bowl of cereal with Semi skim milk | 80g cereal<br>250ml milk | 66 | 16 |
| Tuna Sandwich & Low fat milk | 2 slices of bread and 300ml milk | 68 | 35 |
| Lucozade Recovery Drink | 2 sachets in 500ml water | 54 | 18 |
| SIS Rego Drink | 100g in 1000ml water | 55 | 27 |
| Nesquick | 30g(6 tsps) with 400ml semi skim milk | 50 | 14 |
| Nesquick made up and a Banana | 400ml & medium banana | 73 | 15 |
| Full/semi/skimmed milk & a banana | 500ml & medium banana | 45g | 17 |
| Egg (scrambled/poached or boiled) on toast | 2 eggs & 2 x toast | 40g | 18g |

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