

NUTRITION FOR EXERCISE RECOVERY

AN EXPERT REFRESHER

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Many scientists like to define post-exercise recovery as the restoration of training capacity. But for the amateur team sport athlete, this broad term may be extended to the 'physical and mental readiness for subsequent match or training days', particularly during congested periods of the season. Whereas long-term principles of exercise recovery are most concerned with minimising risk of illness and injury, short-term goals of post-exercise recovery are focussed on maintaining the quality of subsequent training sessions or competitive performance on match day.

While a variety of lifestyle interventions and therapeutic strategies are available to amateur athletes with the goal of aiding exercise recovery (including stretching, hydrotherapy, compression garments, massage, and psychological counselling), here we focus solely on nutritional strategies for post-exercise recovery. These nutritional strategies are often built around the "3 Rs" framework: a mnemonic that stands for rehydrate, refuel, and repair.

This expert refresher explains the multifactorial and interrelated roles of fluids, carbohydrate and protein intake, micronutrients, and supplements in promoting post-exercise recovery for the amateur team sport athlete. We will also cover the three Ts — total, type, and timing — to organise sport nutrition recommendations under each section for post-exercise recovery.

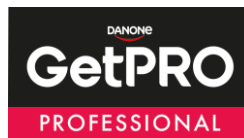
THE 3 R'S FRAMEWORK: REHYDRATE, REFUEL, AND REPAIR

REHYDRATION: FLUID INTAKE

Post-exercise rehydration is defined as the replacement of sweat losses and restoration of body fluid balance. Rehydration is crucial for post-exercise recovery in amateur team sport athletes who often find themselves back on the training pitch or competitive match play setting within a short timeframe (e.g twice weekly training and match play)¹.

Fluid intake guidelines during post-exercise recovery depend on the athlete's individual

sweat rate. The science tells us that sweat rates range from 0.5 to 3 litres per hour among amateur team sport athletes². Factors such as exercise intensity and duration, environmental conditions (heat, humidity, and altitude), and individual characteristics (i.e., body mass, genetic predisposition, heat acclimatization state, physical fitness, and metabolic efficiency) all impact sweat rates for a given activity.



Amateur team sport athletes are recommended to consume 150% of the accrued fluid deficit within 4 hours of recovery³. This guideline accounts for the continued sweating once exercise ends and should be applied right up until a pre-exercise body mass is restored.

Fluids should be consumed early into the post-exercise recovery period and contain somewhere between 50 to 90 mmol per litre of sodium to enhance fluid retention⁴. Thereafter, consumption of sodium-rich foods, such as crackers, peanuts, bread, milk, cheese, ham, and soups, alongside standard drinks (e.g. water) are sufficient to rehydrate the team sport athlete ahead of the next training session or match.

REFUELLING: CARBOHYDRATE IS KING

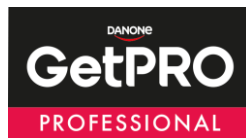
The primary fuel source utilised during prolonged intermittent exercise is muscle glycogen. Therefore, nutritional strategies designed to promote refuelling should focus on restoring muscle glycogen content during post-exercise recovery in amateur team sport athletes.

Current guidelines on post-exercise carbohydrate recommendations for amateur team sport athletes are set at 1.0-1.2 grams per kilogram body mass per hour, depending on exercise intensity⁶. So, a 75 kg amateur team sport athlete engaged in competitive match-play should consume 75-90 g of carbohydrate within the first hour of the final whistle. This carbohydrate dosing strategy should be continued every 2 hours of post-match recovery until regular meals resume. Less emphasis might be placed on total carbohydrate intake guidelines for recovery following lower intensity training sessions

On a practical note, the taste of drinks available during post-exercise recovery should be considered. We know that sweetened drinks are generally preferred and contribute to carbohydrate recommendations for refueling. Milk, or milk-based drinks, are another attractive option during post-exercise recovery. Whereas most sports drinks are formulated with 10-25 mmol per litre of sodium, milk contains 20–30 mmol per litre of sodium and has been shown to enhance post-exercise fluid retention compared with traditional sports drinks (i.e., 6–8% carbohydrate-electrolyte solutions)⁵.

in amateur team sport athletes, particularly when there is ample time between practices⁷.

Various types of carbohydrate-based foods and fluid sources are effective in replenishing muscle glycogen stores. Yet, emphasis should be placed on high glycemic index carbohydrates, particularly during the first hour of post-exercise recovery to kick start the muscle glycogen resynthesis process⁸. The benefit of high glycemic index carbohydrate is because a rapid supply of glucose and large spike in insulin response are key physiological mechanisms that activate the key enzyme (glycogen synthase) which drives muscle glycogen resynthesis. While sucrose is more effective than glucose in restoring liver glycogen levels⁹, the practical relevance of this observation to amateur team sport athletes is likely limited given



that exercise duration does not typically exceed 90-120 minutes.

Protein may also play a role in accelerating muscle glycogen resynthesis rates during post-exercise recovery, but only when carbohydrate intake is suboptimal. Anecdotal reports of gut discomfort are relatively common in amateur athletes after consuming a high carbohydrate feed during immediate post-exercise recovery. In this case, adding approximately 20 grams of

protein (equivalent to 0.3 grams per kilogram body mass for the 75 kg individual) to a suboptimal dose of carbohydrate (0.8 grams per kilogram body mass) is effective in stimulating maximal muscle glycogen resynthesis rates post-exercise¹⁰. No additive effect of protein on muscle glycogen resynthesis is achieved if post-exercise carbohydrate guidelines are met¹¹.

REPAIR

The multi-directional and intermittent movement patterns of amateur team sport athletes¹² require eccentric-based muscle contractions that result in temporary muscle damage, soreness, and reduced function for 2-3 days after match-play¹³. The science is mixed regarding the effectiveness of isolated protein sources such as whey or casein supplements in accelerating the repair of damaged proteins during post-exercise recovery. More promising findings have been reported with protein-rich food sources. For instance, the ingestion of 500ml of milk immediately after muscle-damaging exercise was shown to accelerate muscle repair as determined by the better maintenance of sprint, agility, and repeated

sprint performance during three days of recovery in amateur team sports athletes¹⁴.

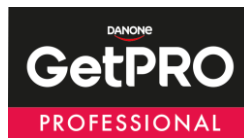
Alongside the repair of old damaged muscle proteins, reconditioning (or remodelling) of new functional proteins is important for recovery in amateur team sport athletes. The optimum dose of protein to maximise muscle protein synthesis as the key metabolic driver of muscle reconditioning equates to 0.3 grams per kilogram body mass per meal that should be spread across 4-5 daily servings¹⁵. Moreover, foods containing slow-releasing proteins, such as milk/dairy which is rich in micellar casein, helps to promote muscle reconditioning during the overnight recovery period¹⁶.

OTHER CONSIDERATIONS

REST

Beyond nutrition, sleep may be regarded as the most important post-exercise recovery strategy for amateur athletes¹⁷. The function of sleep within everyday life relates to permitting recovery from prior wakefulness and preparing oneself mentally and physically for functioning in

the subsequent wake period. So, when we consider the amateur athlete, sleep is fundamental to optimising physical and mental rest if post-exercise recovery extends beyond the initial few hours to the next day or days¹⁸.



Alongside sleep hygiene, daytime napping, and sleep extensions, several nutritional interventions have been investigated in the context of optimising sleep during post-exercise recovery in amateur team sport athletes¹⁹. Current dietary guidelines indicate that evening meals should be served up in solid form²⁰, contain high glycemic index carbohydrates²¹, and a high protein content (including high levels of tryptophan)²², and be ingested 1-3 hours before bedtime in order to enhance sleep quantity (reduced time taken to fall

asleep)²¹ and quality (fewer wake episodes)²².

Examples of high glycemic index foods include white rice, white pasta, bread, and potatoes. Examples of high protein foods that are rich in tryptophan include turkey, chicken, fish, eggs, beans, and leafy green vegetables. Conversely, high fat meals²³ and caffeine intake within 4 hours of bedtime may negatively impact sleep in amateur athletes.

ALCOHOL AND CAFFEINE

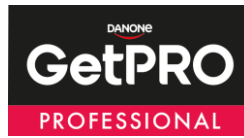
Alcohol intake is likely counter-productive for promoting muscle glycogen resynthesis³⁰ and muscle reconditioning³¹, at least when ingested in high doses.

Therefore, alcohol intake should be moderated during post-exercise recovery. Also, high alcohol- and caffeine-containing beverages have a diuretic effect and should be avoided for post-exercise rehydration³².

SUPPLEMENTS

Where practically possible, athletes should be encouraged to meet their nutritional requirements through real food and drinks. However, it is worth noting that some supplements have demonstrated beneficial effects for aiding recovery in amateur athletes. For example, several studies have shown positive effects of creatine ingestion in promoting phosphocreatine resynthesis³³ during recovery and reducing exercise-induced muscle damage³⁴.

Other nutritional strategies to consider for mitigating muscle damage or accelerating muscle repair include the anti-inflammatory omega-3 polyunsaturated fatty acids²⁵ and various antioxidant-rich juices (e.g., tart cherry, pomegranate, blackcurrant, beetroot) derived from fruits and vegetables²⁴⁻²⁹.



TAKE HOME POINTS

- The 3 Rs (Rehydrate, Refuel, and Repair) are key considerations for post-exercise recovery in amateur team sport athletes.
- Ensure to fully rehydrate after exercise to replace both fluid and sodium lost through sweating.
- Aim to consume carbohydrates with a high glycemic index in the hour post-exercise to refuel the muscle.
- Prioritise protein and omega-3 rich foods to promote muscle repair and reconditioning during post-exercise recovery.



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