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SSE Roundtable #46: Speeding Recovery from Exercise

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Roundtable

SPEEDING RECOVERY FROM EXERCISE

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KEY POINTS

- To hasten recovery after exhaustive exercise, athletes should continue exercising for 10-20 minutes at progressively lower intensities to speed the removal of lactic acid from the muscles and blood. Stretching of all major muscle groups should follow this activity.
- Athletes should begin consuming fluids and carbohydrate immediately after exercise to help the body replace fluids lost in sweat and to replenish muscle glycogen stores.
- Research indicates that a 70 kg (154 lb) athlete should consume 50-150 grams of carbohydrate (200-600 calories) within the first two hours following exercise to optimize the replacement of muscle glycogen stores.
- As little as six grams of protein (more is not better) may accelerate protein synthesis in the muscles following exercise. Expensive protein powders and amino-acid supplements are no more effective than normal foods (e.g., meat, fish, eggs) at providing the necessary amino acids.
- It is important to replace both water and electrolytes (especially sodium) during and following exercise to minimize dehydration, to stabilize blood volume, and to avoid muscle cramps.
- Although there are exceptions, athletes generally require at least 7-8 hours of sleep each night to perform at their best.

INTRODUCTION

A high school tennis player has just finished a grueling three-hour singles match and has only two hours to get ready to play for the doubles championship. Should she simply concentrate on resting for those two hours, or should she be most concerned about refilling her carbohydrate stores and body fluids?

A power lifter completes a tough two-hour training session and must compete for the national title in three days. Should he stop lifting completely until the day of the meet? What should he be eating? Are there supplements he should take to speed his recovery?

During morning competition, an age-group swimmer competes in three preliminary races and qualifies for the evening finals in each. What should she do in the intervening six hours to assure peak performance in the evening events?

All sports medicine professionals, coaches, and athletes have been faced with questions about how best to recover from one bout of exercise and prepare for the next. There are many myths and half-truths about the best approaches to recovery, and there is far more published science on optimal preparation for exercise than on how best to recover from exercise. Therefore, we asked a group of experts who have scientific and/or practical experience in dealing with recovery to help us better understand the recovery process and how to enhance it.

Brad Arnett, head strength and conditioning coach at the University of Arizona in Tucson, works primarily with the football and basketball teams but also has experience working with athletes in a variety of other sports. Dan Benardot is Associate Dean for Research for the College of Health and Human Sciences and co-directs the Laboratory for Elite Athlete Performance at Georgia State University. He was national team nutritionist for USA Gymnastics from 1991-1997 and has authored *Nutrition for Serious Athletes (*Human Kinetics) plus numerous articles in sports nutrition. Ron Maughan is an internationally acclaimed expert in the physiology, biochemistry, and nutrition of exercise performance. He has published extensively on these topics in the scientific literature. Brent Steuerwald has been a varsity high school football coach for 43 years. In 1995 the National High School Athletic Coaches Association named him National Coach of the Year in Football. He works with the National Football League in developing educational programs to improve football coaching across the nation. Fred Tedeschi is the head athletic trainer with the Chicago Bulls. He previously held similar positions with the University of California, Berkeley, and with Vanderbilt University, and he was also an assistant athletic trainer with the San Francisco 49ers for seven years.

"Recovery" may have different meanings, depending on the sport in question and on other factors. How do you define "recovery" in the sport settings with which you are most familiar?

Benardot: Recovery is the process the athlete goes through to return to a state of performance readiness. Recovery involves a restoration of nutrient and energy stores, a return to normal physiological function, a lessening of muscle soreness, and the disappearance of the psychological symptoms (irritability, disorientation, inability to concentrate) associated with extreme fatigue. Regardless of whether the athletes I work with are figure skaters, gymnasts, marathon runners, tennis players, or hockey players, the goal is to get the athlete ready to compete again or to make certain the next practice session enhances performance potential. There is no question that athletes who train or compete without fully recovering from a prior competition or training session will not train or compete at their best.

Maughan: I agree with Dr. Benardot that recovery must involve both physical and mental restoration. In training, this allows the quality of the workout to be maintained while

minimizing the risk of chronic fatigue, illness, and injury. In competition, it means being able to take part in the next round or event and to perform at the same or at a higher level.

What types of "cool-down" activities do you recommend that athletes perform immediately following a session of intense training or competition that lasts 1-2 hours?

Steuerwald: Immediately following any training session or competition, athletes should "taper down" their exercise to a lower level of intensity. This should include non-sport-specific physical activity (e.g., jogging or swimming a different stroke) that gradually decreases in intensity over the duration of the cool-down. Following this, athletes should stretch all major muscle groups. If competition is to resume shortly, athletes should be encouraged to remain warm and mildly active.

Tedeschi: Athletes should ramp up into any exercise activity and ramp down after activity, regardless of the duration of the exercise. As Coach Steuerwald indicated, cooling down should consist of submaximal exercise followed by a stretching regimen. In addition, as the last component of cooling down after exercise, athletes should consume carbohydrates to enhance replenishment of carbohydrate stores.

Maughan: After a hard workout, 10-20 minutes of gentle exercise can speed removal of lactic acid from the muscles and promote recovery. If another competition will follow soon, restoration of fluid balance and replenishment of glycogen stores are priorities, so there should be time for fluids and/or food immediately after finishing exercise but before beginning the cool-down activity. I agree with the other participants that stretching should also occur following the cool-down exercise.

Benardot: I would like to expand on Dr. Maughan?s emphasis on replenishing fluids and carbohydrate stores. Because intense physical activity is likely to lead to a severe depletion of carbohydrate stores (glycogen) and to dehydration, two main goals following intense exercise should be to replace this fuel in addition to the fluid and electrolytes that were lost in sweat. Drinking fluids is also important to return blood volume and total body water to pre-exercise levels. A note of caution: Athletes who must compete again in a relatively short period of time must be careful to not consume such a large amount of food and fluid that a large portion of it remains in the stomach at the start of the next event. These athletes should focus on smaller amounts of foods and drinks containing glucose, sucrose, or maltodextrins? carbohydrates that can quickly leave the stomach and become absorbed. The athlete who won?t exercise again for another 24-hours can be more liberal with the type and amount of carbohydrate and fluid consumed.

Do you advise athletes to consume carbohydrate foods to speed recovery?

Arnett: I recommend that athletes consume a high-glycemic blend of maltodextrins, dextrose (glucose), and sucrose to speed recovery. Assuming no further competition or strenuous training for at least 24 hours, an athlete whose lean body mass is 200 pounds (91 kg) should begin consuming about 160 grams of carbohydrate and 60 grams of protein immediately following a workout and finish consuming these nutrients within the next couple of hours.

Maughan: Carbohydrate is an absolute must. The amount and type of carbohydrate will depend on the circumstances, but there are advantages to a liquid form when the athlete does not feel like eating immediately after exercise. If the athlete has roughly 24 hours to recover, the usual recommendation for a 154-pound (70-kg) athlete is at least 50-150 grams of carbohydrate within two hours immediately following exercise. We try to help the athlete by identifying food portions that will give this amount of carbohydrate. For example, you need about 200 grams of pasta to get 50 grams of carbohydrate, but you can also get 50 grams of carbohydrate from about 80 grams of raisins or about 700 ml (24 oz) of a sports drink. Athletes are more likely to have a candy bar and a sports drink than potatoes or pasta in

their sports bags, so there needs to be an immediate fueling option followed by a focus on carbohydrate foods at the first visit to the dining table.

Benardot: Sure, carbohydrate is crucial, but vitamins, minerals, and energy substrates (protein, carbohydrate, and fat) all play important roles in optimal nutrition. A monotonous emphasis on any single nutrient or energy substrate may disturb the relationships among these nutrients and make it difficult for the athlete to achieve an optimal nutritional state. So carbohydrate should not be the *exclusive* focus of our attention as a strategy for speeding recovery. Foods that contain a high proportion of carbohydrates, but also some protein and a small amount of fat, are suitable for encouraging recovery. The amounts needed depend on the size of athlete, the degree of carbohydrate depletion, and the severity of fluid loss. For smaller athletes who have multiple competitions within a day, I might recommend a 200-250 calorie (1 MJ) energy bar or other snack containing mainly carbohydrate, along with 12 to 16 ounces (350-475 ml) of a sports drink to wash it down. This amount of food would increase proportionately with the size of the athlete and the situation. I encourage athletes who are finished for the day to consume 250-400 calories (1-1.8 MJ) of foods high in carbohydrates (pretzels, bread, fruit) with fluids before they shower, and then to eat the same amount after they shower and dress.

How can athletes optimize their stores of body fluids to help speed recovery from exercise? Is hydration important only in hot environments, or should those participating in winter sports be concerned, too?

Benardot: Physical activity, regardless of the environmental condition, causes an increase in body heat production and, therefore, a loss of sweat, which can lead to dehydration. Novice skiers are often surprised when they find that their clothes are soaked in sweat, even though the air temperature is bitterly cold. The ideal strategy is to maintain fluid balance during the event to *avoid* dehydration. Sweat losses may exceed the athlete?s capacity to adequately replace fluids, particularly in hot environments, so paying special attention to fluid consumption at every opportunity reduces the risk that water loss may induce premature fatigue. As a goal, the athlete should drink as much as is tolerable as often as possible during the event, and then enough following the event to return body weight to its pre-event weight. Carbohydrates in fluids have the effect of improving rates of fluid absorption by the intestines (a 6-7% carbohydrate solution is considered best), and the carbohydrates also help to replenish the muscle glycogen used during the exercise.

Maughan: Fluid replacement is a key issue. Athletes should begin the recovery process during training or competition by drinking fluids to minimize the fluid deficit that is incurred. Replacement of fluids after exercise should be based on need. You can tell how much sweat was lost by weighing yourself before and after a workout. We know that you should drink about 1.5 liters (50 oz) of fluid for every kilogram (2.2 lbs) of weight loss, and we also know that you won?t rehydrate effectively unless you also replace the salts lost in sweat. Some winter sports athletes actually lose more fluid than those competing in warm environments because the insulation provided by winter clothing can reduce heat loss and thus promote sweating. Even in a game like soccer, with limited clothing, sweat rates can be high on a winter day.

Tedeschi: I agree that appropriate hydration is important in any climate. An ideal or near ideal state of hydration can be achieved through a regimen of drinking before and during exercise and drinking after exercise in amounts sufficient to replace any lost weight during exercise. In addition, ample research has demonstrated that a sports drink like Gatorade is superior to plain water for optimizing the stores of body fluids.

Steuerwald: I?m happy to jump on this "hydration-in-all-environments" bandwagon. In my experience, if athletes practice drinking during training sessions, they can learn to tolerate the consumption of greater fluid volumes during exercise and thereby reduce the incidence of serious dehydration.

Are electrolytes important in speeding recovery from exercise? If so, which ones?

Maughan: Electrolyte replacement is crucial. Salts act like a sponge, holding fluid in the body. If you drink a large volume of plain water, the body thinks that it is over-hydrated because the water dilutes the concentrations of sodium and other dissolved substances in the blood. This switches off thirst and switches on the kidneys to increase urine output. Sodium is the most important electrolyte as it is the one lost in sweat in the greatest amounts, and that?s why it is added to sports drinks.

Benardot: There are other minerals in sweat, including magnesium, but the amounts lost are insignificant compared to sodium and potassium. Sodium in fluids is particularly important because, as Dr. Maughan said, sodium drives the desire to drink (a good thing), and the sodium also helps to maintain blood volume. The maintenance of blood volume is considered to be vital to sustaining athletic performance

Steuerwald: I, too, am firmly convinced that sodium and potassium replacement is important in speeding recovery from exercise. Athletes can replace these electrolytes by consuming sports drinks, fruits, vegetables, and other foods and beverages rich in sodium and potassium.

Tedeschi: In addition to its beneficial effects on maintaining body fluids, replacement of sodium and potassium can also help prevent muscle cramps during and after exercise. To be sure they are replacing lost electrolytes, I tell athletes to use sports drinks that contain sodium, eat ample fruits and green leafy vegetables, and lightly salt their food.

How important are protein supplements and/or other dietary supplements as aids to rapid recovery?

Arnett: A recent report by Blomstrand and Saltin suggests that branched-chain amino acids (leucine, isoleucine, and valine) may have a protein sparing effect. I also recommend that athletes take glutamine following exercise to speed recovery.

Maughan: The evidence now emerging suggests that there may be benefits from taking protein immediately after exercise to help the process of building and repairing muscles. The aim of training is to remodel the muscles and other tissues. This means we are breaking down some of the older proteins and making newer ones. At present, the timing and amount of protein that will be optimal is not clear, but early research indicates that very small amounts of protein may be effective; for example, six grams of protein are just as effective as larger amounts at stimulating protein synthesis after exercise. The research evidence I have seen does not support Coach Arnett's earlier suggestion that an athlete might need 60 grams of protein during recovery. Moreover, the best research shows that consuming individual amino acids, including branched-chain amino acids and glutamine, provides no advantage over proteins. Finally, given that carbohydrate is also needed during recovery, a sandwich with ham, cheese, or tuna, together with a drink, may be an effective option as a recovery "supplement."

Benardot: The only supplement I recommend is Vitamin E, an antioxidant that may help athletes reduce the oxidative stress and tissue damage associated with exercise. I agree that a small amount of protein may be useful in aiding muscle recovery, but many athletes consume excessive quantities of proteins or amino acids. It is likely that most, if not all, of any benefit derived from consuming large amounts of protein (more than 1.5 grams of protein per kilogram (2.2 lbs) of body weight) and/or amino acids can be attributed to the role these supplements play in helping the athletes meet their caloric needs rather than their protein needs.

Tedeschi: I am not convinced of the need for protein or amino acid supplementation. If athletes eat calorically sufficient diets, they most likely are getting more than enough protein

and amino acids. I believe the real benefit of foods for speeding recovery lies in carbohydrate feeding.

Steuerwald: Fred and I have similar views on this issue. I do not encourage the use of any supplements to aid recovery. There are many foods and drinks that can naturally replace nutrients that are lost through training and competition.

How important is adequate sleep in optimizing recovery from exercise? How much sleep do you think most athletes should get?

Benardot: Getting sufficient sleep is just as important a part of training as practicing the skills of the sport, lifting weights, or improving endurance. Clearly, muscles that have worked so hard in training to get bigger or stronger need adequate rest to rebuild themselves in a way that can help the athlete perform better. I don?t know any hard working athlete who needs less than seven hours of sleep each day, and most athletes could probably do better with eight hours. With all of the time demands on many athletes, getting enough sleep won?t happen by accident. It must be a planned part of the training schedule.

Maughan: Some people survive and even thrive on much less sleep than do others, so I don?t think blanket recommendations are a good idea. Individual athletes should determine their own needs. I believe that if we listen to our own bodies, we can?t go far wrong. Routine is important to many athletes, but experience suggests that missing a few hours because of a late night the day before an event may not necessarily do much harm, so athletes should not worry if travel or other factors cause disruptions.

Tedeschi: One of the signs of overtraining is sleep difficulty. Given the time devoted to team travel and other commitments in athletics, it is often difficult to get the necessary rest. I advocate at least 8-10 hours of sleep to enhance recovery from exercise.

SUGGESTED ADDITIONAL READING:

Blomstrand, E. and B. Saltin (2001). BCAAintake affects protein metabolism in muscle after but not during exercise in humans. *Am. J. Physiol*. 281:E365-E374.

Gibala, M.J. (2000). Nutritional supplementation and resistance exercise: What is the evidence for enhanced skeletal muscle hypertrophy? *Can. J. Appl. Physiol*. 25:524-35.

Jentjens, R.L., L.J. van Loon, C.H. Mann, A.J. Wagenmakers, and A.E. Jeukendrup (2001). Addition of protein and amino acids to carbohydrates does not enhance postexercise muscle glycogen synthesis. *J. Appl. Physiol.* 91:839-46.

Maughan, R.J. (2000). Food and fluids before, during and after exercise. In: Shephard, R.J. (ed.) *Endurance in Sport*. Blackwell: Oxford, UK, pp. 409-422.

Rapid Recovery After a Workout or Competition

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Training sessions and competitions can make you feel totally exhausted. If you don?t recover properly, you will not be ready to perform well during the next training period or competition. A failure to recover adequately can eventually lead to overtraining and staleness. What is optimal recovery? All of your body systems should be returned to the

state they were in before exercise. You want to rid your muscles of lactic acid and other waste products, replenish all the energy sources you used to fuel your exercise, fill up your body fluid reservoirs, minimize any muscle or joint damage resulting from exercise, and re-energize your brain cells. Here are some recovery tips that will help you feel more energetic and ready to take on the world.

- **Don?t Lie Down on the Job**
  After exhaustive exercise, don?t stop and rest immediately. You can speed up the removal of lactic acid from your muscles by continuing to exercise at a low intensity for 10-20 minutes. This cool-down exercise can help reduce the feelings of stiffness that you may experience after a workout and is especially important if your next round of competition is only a few hours away.

- **Stretch Mostly After Exercise, Not Before**
  Stretch your major muscle groups after your cool-down exercise to get the maximal benefits of stretching. If you stretch your muscles, tendons, and ligaments too aggressively before beginning your exercise, you risk damaging those tissues. Rather, wait until the tissues are warmed up by exercise, and you can perform better stretches that will minimize muscle soreness and may help prevent future muscle pulls and other injuries.

- **Fuel Up Fast**
  The muscles are primed for quick restoration of their carbohydrate fuel reserves (glycogen) immediately after exercise, so don?t wait to start eating foods and drinking beverages rich in carbohydrate. Pretzels, fresh fruits, energy bars, sports drinks, and even jellybeans all contain lots of carbohydrate.

- **Carbohydrate is Best, But Some Protein Can?t Hurt**
  During strenuous exercise, some proteins in the muscles are broken down. For faster buildup of muscle proteins during recovery, include a small amount of protein in your food intake. To combine both carbohydrate and protein, try a ham or tuna sandwich. Most energy bars contain ample carbohydrate and protein to get your muscles on the road to recovery. So do foods like milk, cheese, eggs, and nutrition shakes.

- **Fill Up Your Tank**
  Body fluids are lost in sweat, and quickly replacing that fluid is crucial. Fluids are needed to maintain your blood volume so you can deliver oxygen and fuel to your muscles. Moreover, without enough fluids, you can't sweat to help keep your body temperature at safe levels. You should top off your body fluids by drinking an hour or so before exercise, try to replace as much sweat loss as you can during exercise, and replace any body weight lost during exercise by drinking while you are recovering.

- **Salt is Super**
  When you sweat, your body loses both water and electrolytes (mostly salt?sodium chloride?and some potassium). If you drink only plain water during exercise and recovery, you will have difficulty replacing your body fluids rapidly because much of the water will pass through your kidneys to become urine. You must replace the salt along with the water to counteract dehydration. Especially if you will compete again in a few hours, consider using sports drinks during recovery for fast replacement of water, salt, and carbohydrate. Also, make sure you put some extra salt on your foods at mealtime, particularly if you are prone to cramping.

- **Healing Helpers**
  When your muscles and joints are aching after exercise, you may be experiencing the effects of inflammatory processes and swelling that follow minor damage to your tissues. To minimize this inflammation, try using massage, cold packs around your

joints, alternating cold and hot whirlpool baths, and small doses of aspirin or other anti-inflammatory products. Don?t expect miracles; these techniques may not work for you, but many athletes find them useful.

- **Sleep Well**
  A good night?s sleep helps you get physically and mentally prepared for your next workout or competition. You can?t perform at your best when you are not alert and are unable to concentrate on your sport. Some athletes can get by for a day or two with inadequate sleep and still perform well, but poor sleep habits will eventually lead to poor performance. So try to get into a routine of at least 7-8 hours of sleep each night to ensure full recovery from your last training session or competition.

SUGGESTED ADDITIONAL READING:

Gibala, M.J. (2000). Nutritional supplementation and resistance exercise: What is the evidence for enhanced skeletal muscle hypertrophy? Can. J. Appl. Physiol. 25:524-35.

Maughan, R.J. (2000). Food and fluids before, during and after exercise. In: Shephard, R.J. (ed.) Endurance in Sport. Blackwell: Oxford, UK, pp. 409-422.