**Rest and Recovery After Exercise - Improve Sports Performance**

**After Exercise Rest - Why Rest Days Improve Sports Performance**

With thanks to [Elizabeth Quinn](http://sportsmedicine.about.com/bio/Elizabeth-Quinn-3502.htm) for sharing her article with WWA.

Most athletes know that getting ***enough rest after exercise is essential to high-level performance***, but many still over train and feel guilty when they take a day off. The body repairs and strengthens itself in the time between workouts, and continuous training can actually weaken the strongest athletes. Rest days are critical to sports performance for a variety of reasons. Some are physiological and some are psychological. Rest is physically necessary so that the muscles can repair, rebuild and strengthen. For recreational athletes, building in rest days can help maintain a better balance between home, work and fitness goals.

In the worst-case scenario, too few rest and recovery days can lead to [**overtraining syndrome**](http://sportsmedicine.about.com/cs/overtraining/a/aa062499a.htm) - a difficult condition to recover from.

Overtraining syndrome frequently occurs in athletes who are training for competition or a specific event and train beyond the body's ability to recover. Athletes often exercise longer and harder so they can improve. But without adequate rest and recovery, these training regimens can backfire, and actually decrease performance.

Conditioning requires a balance between overload and recovery. Too much overload and/or too little recovery may result in both physical and psychology symptoms of overtraining syndrome.

**Common Warning Signs and Symptoms of Overtraining Syndrome**

* Washed-out feeling, tired, drained, lack of energy
* Mild leg soreness, general aches and pains
* Pain in muscles and joints
* Sudden drop in performance
* Insomnia
* Headaches
* [Decreased immunity](http://sportsmedicine.about.com/cs/exercisephysiology/a/aa100303a.htm) (increased number of colds, and sore throats)
* Decrease in training capacity / intensity
* Moodiness and irritability
* Depression
* Loss of enthusiasm for the sport
* Decreased appetite
* Increased incidence of injuries.
* [A compulsive need to exercise](http://sportsmedicine.about.com/cs/eatingdisorders1/a/compulsive_ex.htm)

**Recognizing Overtraining Syndrome**

There are several ways you can objectively measure some signs of overtraining. One is by documenting your heart rates over time. Track your aerobic heart rate at a specific exercise intensities and speed throughout your training and write it down. If your pace starts to slow, your resting heart rate increases and you experience other symptoms, you may heading into overtraining syndrome.

You can also track your resting heart rate each morning. Any marked increase from the norm may indicated that you aren't fully recovered.

Another way to test recover to use something called the orthostatic heart rate test, developed by Heikki Rusko while working with cross country skiers. To obtain this measurement:

* Lay down and rest comfortably for 10 minutes the same time each day (morning is best).
* At the end of 10 minutes, record your heart rate in beats per minute.
* Then stand up
* After 15 seconds, take a second heart rate in beats per minute.
* After 90 seconds, take a third heart rate in beats per minute.
* After 120 seconds, take a fourth heart rate in beats per minute.

Well rested athletes will show a consistent heart rate between measurements, but Rusko found a marked increase (10 beats/minutes or more) in the 120 second-post-standing measurement of athletes on the verge of overtraining. Such a change may indicate that you have not recovered from a previous workout, are fatigued, or otherwise stressed and it may be helpful to reduce training or rest another day before performing another workout.

A [training log](http://erclk.about.com/?zi=8/qBw) that includes a note about how your feel each day can help you notice downward trends and decreased enthusiasm. It's important to listen to your body signals and rest when you feel tired.

You can also ask those around you if they think you are exercising too much.

While there are many proposed ways to objectively test for overtraining, the most accurate and sensitive measurements are psychological signs and symptoms and changes in an athlete's mental state. Decreased positive feelings for sports and increased negative feelings, such as depression, anger, fatigue, and irritability often appear after a few days of intensive overtraining. Studies have found increased [ratings of perceived exertion](http://sportsmedicine.about.com/cs/strengthening/a/030904.htm) during exercise after only three days of overload.

**How to Treat Overtraining Syndrome**

If you suspect you are overtraining, start with the following:

* [Rest and Recover](http://sportsmedicine.about.com/od/sampleworkouts/a/RestandRecovery.htm). Reduce or stop exercise and allow yourself a few days of rest.
* [Hydrate](http://sportsmedicine.about.com/cs/nutrition/a/aa011599a.htm), Drink plenty of fluids and alter your diet if necessary.
* [Get a sports massage](http://sportsmedicine.about.com/od/injuryprevention/a/Sports_Massage.htm). This may help relax you mentally and physically.
* [Begin Cross Training](http://sportsmedicine.about.com/od/tipsandtricks/a/Cross_Training.htm). This often helps athletes who are overworking certain muscles or suffering from mental fatigue.

Research on overtraining syndrome shows getting adequate rest is the primary treatment plan. New evidence indicating that low levels of exercise, or [active recovery](http://sportsmedicine.about.com/od/tipsandtricks/a/activerecovery.htm), during the rest period speeds recovery, and [Moderate exercise increases immunity](http://sportsmedicine.about.com/cs/injuryprevention/a/aa011502a.htm).

***Total recovery from overtraining can take several weeks and should include proper nutrition and stress reduction.***

**How to Prevent Overtraining Syndrome**

It's often hard to predict overtraining because every athlete responds differently to certain training routines. It is important, however, to vary training through the year and schedule in significant rest time. The following tips may help you avoid overtraining.

**What Happens During Recovery?**

Building recovery time into any training program is important because this is the time that the body adapts to the stress of exercise and the real training effect takes place. Recovery also allows the body to replenish energy stores and repair damaged tissues. Exercise or any other physical work causes changes in the body such as muscle tissue breakdown and the depletion of energy stores (muscle glycogen) as well as fluid loss.

Recovery time allows these stores to be replenished and allows tissue repair to occur. Without sufficient time to repair and replenish, the body will continue to breakdown from intensive exercise. Symptoms of [overtraining](http://sportsmedicine.about.com/cs/overtraining/a/aa062499a.htm) often occur from a lack of recovery time. Signs of overtraining include a feeling of general malaise, staleness, depression, decreased sports performance and increased risk of injury, among others.

**Short and Long-Term Recovery**

Keep in mind that there are two categories of recovery. There is immediate (short-term) recovery from a particularly intense training session or event, and there is the long-term recovery that needs to be build into a year-round training schedule. Both are important for optimal sports performance.

**Short-term recovery**, sometimes called [active recovery](http://sportsmedicine.about.com/od/tipsandtricks/a/activerecovery.htm) occurs in the hours immediately after intense exercise. Active recovery refers to engaging in low-intensity exercise after workouts during both the cool-down phase immediately after a hard effort or workout as well as during the days following the workout. Both types of active recovery are linked to performance benefits. After athletic competition or a hard workout, it would seem that complete rest would be the best way to encourage recovery. However, research is beginning to find some advantages in active recovery. Active recovery refers to engaging in low-intensity exercise after workouts. There are two forms of active recovery. One is during the cool-down phase immediately after a hard effort or workout. The second form of active recovery includes the days following a competition or other intense workout. Research is growing on the benefits of both types of active recovery.

One study published in *Medicine & Science in Sports and Exercise* (1) found that active recovery immediately after the event encourages recovery and reduces muscle lactate levels faster than complete rest. After hard intervals, one group rested completely while a second group exercised at 30 percent intensity between intervals. The active group reduced blood lactate levels faster and could achieve a higher power output throughout the workout.

Another study (2) found that adding low intensity exercise to the rest period after competition did not decrease an athlete's physical recovery and actually had positive effects on psychological recovery by improving relaxation.

A third study found active recovery encouraged lactic acid removal and and helped speed recovery. (3) The general theory is that low-intensity activity assists blood circulation which, in turn, helps remove lactic acid from the muscle. Low-intensity active recovery appears to significantly reduce accumulated blood lactate and speed muscle recovery. However, all agree that more study is necessary to establish a clear answer regarding the best way to recover from intense exercise.

**The Bottom Line**
Active rest appears to allow an athlete to physically and psychologically recover from the stresses of training and competing while still maintaining fitness levels. It is becoming a common part of most training plans and appears to offer more benefit than harm. Consider adding a bit of easy, low-intensity exercise to your post-competition recovery plan and see if you feel better faster.

Another major focus of recovery immediately following exercise has to do with replenishing energy stores and fluids lost during exercise and optimizing protein synthesis (the process of increasing the protein content of muscle cells, preventing muscle breakdown and increasing muscle size) by eating the right foods in [the post-exercise meal](http://sportsmedicine.about.com/cs/nutrition/a/aa081403.htm). Most athletes know of the importance of [eating before exercise](http://sportsmedicine.about.com/od/sportsnutrition/a/EatForExercise.htm), however, what and when you eat after exercise can be just as important. While the pre-exercise meal can ensure that adequate glycogen stores are available for optimal performance (glycogen is the the source of [energy most often used for exercise](http://sportsmedicine.about.com/od/sportsnutrition/a/Carbohydrates.htm)), the post-exercise meal is critical to recovery and improves your ability to train consistently.

**Hydration After Exercise**
The first nutritional priority after exercise is to [replace any fluid lost](http://sportsmedicine.about.com/cs/hydration/a/aa041103a.htm) during exercise. In general the best way to determine how much to drink (either water of a sports drink) is to:

* Weigh yourself before and after exercise and replace fluid losses.
* Drink 20-24 fl oz water for every 1 lb lost.

**Eating After Exercise**
It is also important to consume [carbohydrate](http://sportsmedicine.about.com/od/sportsnutrition/a/Carbohydrates.htm), such as fruit or juice) within 15 minutes post-exercise to help restore glycogen.

Research has shown that eating 100-200 grams of carbohydrate within two hours of endurance exercise is essential to building adequate glycogen stores for continued training. Waiting longer than two hours to eat results in 50 percent less glycogen stored in the muscle. The reason for this is that carbohydrate consumption stimulates insulin production, which aids the production of muscle glycogen. However, the effect of carbohydrate on glycogen storage reaches a plateau.

**Carbohydrate Plus Protein Speeds Recovery**
Research shows that combining protein with carbohydrate in the two hours after exercise nearly doubles the insulin response, which results in more stored glycogen. The optimal carbohydrate to protein ratio for this effect is 4:1 (four grams of carbohydrate for every one gram of protein). Eating more protein than that, however, has a negative impact because it slows rehydration and glycogen replenishment.

One study found that athletes who refueled with carbohydrate and protein had 100 percent greater muscle glycogen stores than those who only ate carbohydrate. Insulin was also highest in those who consumed a carbohydrate and protein drink.

[**Protein**](http://sportsmedicine.about.com/od/sportsnutrition/a/Protein.htm) **Needs After Exercise**
Consuming protein has other important uses after exercise. Protein provides the amino acids necessary to rebuild muscle tissue that is damaged during intense, prolonged exercise. It can also increase the absorption of water from the intestines and improve muscle hydration. The amino acids in protein can also stimulate the immune system, making you more resistant to colds and other infections.

**Bottom Line**
If you are looking for the best way to refuel your body after long, strenuous endurance exercise, a 4:1 combo of carbohydrate and protein seems to be your best choice. While solid foods can work just as well as a sports drink, a drink may be easier to digest make it easier to get the right ratio and meet the 2-hour window.

This is also the time for soft tissue (muscles, tendons, ligaments) repair and the removal of chemicals that build up as a result of cell activity during exercise.

**Long-term recovery** techniques refer to those that are built in to a seasonal training program. Most well-designed training schedules will include recovery days and or weeks that are built into an annual training schedule. This is also the reason athletes and coaches change their training program throughout the year, add [crosstraining](http://sportsmedicine.about.com/od/tipsandtricks/a/Cross_Training.htm), modify workouts types, and make changes in intensity, time, distance and all the other training variables.

**Adaptation to Exercise**

[The Principle of Adaptation](http://sportsmedicine.about.com/cs/conditioning/a/aa050901a.htm) states that when we undergo the stress of physical exercise, our body adapts and becomes more efficient. It’s just like learning any new skill; at first it’s difficult, but over time it becomes second-nature. Once you adapt to a given stress, you require additional stress to continue to make progress.

There are limits to how much stress the body can tolerate before it breaks down and risks injury. Doing too much work too quickly will result in injury or muscle damage, but doing too little, too slowly will not result in any improvement. This is why personal trainers set up specific training programs that increase time and intensity at a planned rate and allow rest days throughout the program.

[**Sleep Deprivation Can Hinder Sports Performance**](http://sportsmedicine.about.com/cs/conditioning/a/aa062800a.htm)

In general, one or two nights of poor or little sleep won't have much impact on performance, but consistently getting inadequate sleep can result in subtle changes in hormone levels, particularly those related to stress, muscle recovery and mood. While no one completely understands the complexities of sleep, some research indicates that sleep deprivation can lead to increased levels of cortisol (a stress hormone), decreased activity of human growth hormone (which is active during tissue repair), and decreased [glycogen synthesis](http://sportsmedicine.about.com/od/sportsnutrition/a/Carbohydrates.htm). All the energy we need for life as well as for exercise comes from the food we eat and the [fluids](http://sportsmedicine.about.com/cs/hydration/a/aa041103a.htm) we drink. These nutrients are commonly broken into three classes:

* ***Carbohydrates***
* Carbohydrate is arguably the most important source of energy for athletes. No matter what sport you play, carbs provide the

energy that fuels muscle contractions. Once eaten, carbohydrates breakdown into smaller sugars (glucose, fructose and galactose) that get absorbed and used as energy. Any glucose not needed right away gets stored in the muscles and the liver in the form of glycogen. Once these glycogen stores are filled up, any

extra gets stored as fat.

* Glycogen is the source of energy most often used for exercise. It is needed for any short, intense bouts of exercise from sprinting

to weight lifting because it is immediately accessible. Glycogen also supplies energy during the first few minutes of any sport.

During long, slow duration exercise, fat can help fuel activity, but glycogen is still needed to help breakdown the fat into

something the muscles can use.

* Adequate carbohydrate intake also helps prevent protein from being used as energy. If the body doesn’t have enough

carbohydrate, protein is broken down to make glucose for energy. Because the primary role of protein is as the building blocks

for muscles, bone, skin, hair, and other tissues, relying on protein for energy (by failing to take in adequate carbohydrate)

can limit your ability to build and maintain tissues. Additionally, this stresses the kidneys because they have to work harder to

eliminate the byproducts of this protein breakdown.

* Carbohydrate has other specific functions in the body including fueling the central nervous system (CNS) and brain.
* **Storing Carbohydrate**
One gram of carbohydrate provides four calories of energy. Athletes often talk about carbohydrate loading and carbohydrate

depletion which refers to the amount of carbohydrate energy we can store in our muscles. This is generally around 2,000

carbohydrate calories, but we can change this number through depletion and loading. During depletion (from diet, exercise or a

combination) we use up the stored carbohydrate.

* If we don’t replenish these stores, we can run out of fuel for immediate exercise. Athletes often refer to this as "bonking" or

 "hitting the wall." In the same way, eating large amounts of carbohydrates can increase these stores. This is often referred

to as carbohydrate loading or carbo-loading. Our maximal carbohydrate storage is approximately 15 grams per kilogram of

body weight [15 grams per 2.2 pounds]. So a 175-pound athlete could store up to 1200 grams of carbohydrate [4,800 calories];

 enough energy to fuel high intensity exercise for quite some time.

* **How Carbohydrate Fuels Exercise**
Carbohydrate stored as glycogen is an easily accessible source of energy for exercise. How long this energy supply lasts

depends on the length and intensity of exercise and can range anywhere from 30 to 90 minutes or more. To avoid running

out of energy during exercise, start with full glycogen stores, replenish them during exercise and refill them after exercise

to be ready for the next workout.

* **Types of Carbohydrate**
Carbohydrates are also divided into simple and complex forms. Simple sugars (carbs) are absorbed and converted to energy

very quickly and provide a rapid source of energy. Fruit and energy drinks are a good source of simple carbohydrates.

* Complex carbohydrates take a bit longer to be digested and absorbed into the body. They also take longer to breakdown and

therefore provide energy at a slower rate than simple sugars. Examples of complex carbohydrates are breads, rice and pasta.

Starch and fiber are also considered complex carbohydrates but fiber can not be digested or used for energy. Starch is

probably the most important energy source in an athlete’s diet because it is broken down and stored as glycogen.

Foods high in starch include whole grain breads, cereals, pasta, and grains.

* [***Fats***](http://sportsmedicine.about.com/od/sportsnutrition/a/Fat.htm)

**Sports Nutrition - Fat**
Dietary fat is often blamed for many health problems; however, fat is an essential nutrient for optimal health. Adipose tissue (stored fat) provides cushion and insulation to internal organs, covers the nerves, moves vitamins (A, D, E, and K) throughout the body and is the largest reserve of stored energy available for activity. Fat is stored when we consume more calories then we use. There is an [optimal level of body fat](http://sportsmedicine.about.com/cs/body_comp/a/aa012599a.htm) for health and for athletic activity. When that optimal level is exceeded, too much dietary fat can lead to problems with health as well as athletic performance.

**Types of Dietary Fat**

* **Saturated fats** are found primarily in animal sources like meat, egg yolks, yogurt, cheese, butter, milk. This type of fat is often solid at room temperature. Too much saturated fat has been linked to health problems such as high cholesterol and heart disease. Because of this, saturated fat should be limited to no more than 10% of total daily calorie intake.
* **Unsaturated fats** include monounsaturated and polyunsaturated fats, which are typically found in plant food sources and are usually liquid at room temperature. Unsaturated fats have health benefits such as lowering cholesterol and reducing the risk of heart disease. Common food sources include olive and canola oil, avocados, fish, almonds, soybeans and flaxseed.
* **Trans fat** has recently been added to the nutrition labels of most products. Trans fatty acids are created (naturally or man-made) when an unsaturated fat is made into a solid. Trans fats, like saturated fat, should be limited because they increase cholesterol levels and the risk of heart disease.

**How Fat Provides Energy for Sports**
Fat provides the highest concentration of energy of all the nutrients. One gram of fat equals nine calories. This calorie density, along with our seemingly unlimited storage capacity for fat, makes fat our largest reserve of energy. One pound of stored fat provides approximately 3,600 calories of energy. While these calories are less accessible to athletes performing quick, intense efforts like sprinting or weight lifting, fat is essential for longer, slower lower intensity and endurance exercise such as easy cycling and walking.

Fat provides the main fuel source for long duration, low to moderate intensity exercise (endurance sports such as marathons, and ultra marathons). Even during high intensity exercise, where carbohydrate is the main fuel source, fat is needed to help access the stored carbohydrate (glycogen).

Using fat for fuel for exercise, however, is dependent upon these important factors:

* Fat is slow to digest and be converted into a usable form of energy (it can take up to 6 hours).
* Converting stored body fat into energy takes time. The body needs to breakdown fat and transport it to the working muscles before it can be used as energy.
* Converting stored body fat into energy takes a great deal of oxygen, so exercise intensity must decrease for this process to occur.

For these reasons, athletes need to carefully time when they eat fat, how much they eat and the type of fat they eat. In general, it’s not a great idea to eat fat immediately before or during intense exercise.

* [***Proteins***](http://sportsmedicine.about.com/od/sportsnutrition/a/Protein.htm)

Proteins are often called the building blocks of the body. Protein consists of combinations of structures called amino acids that combine in various ways to make muscles, bone, tendons, skin, hair, and other tissues. They serve other functions as well including nutrient transportation and enzyme production. In fact, over 10,000 different proteins are in the body.

Adequate, regular protein intake is essential because it isn’t easily stored by the body. Various foods supply protein in varying amounts with complete proteins (those containing 8 essential amino acids) coming mostly from animal products such as meat, fish, and eggs and incomplete protein (lacking one or more essential amino acid) coming from sources like vegetables, fruit and nuts. Vegetarian athletes may have trouble getting adequate protein if they aren’t aware of how to combine foods.

**Learn More:** [**Tips for Vegetarian Athletes**](http://sportsmedicine.about.com/od/sportsnutrition/a/VegetarianTips.htm)

If you don’t eat meat, it can take a bit more planning to get adequate protein for muscle building and sports training. Vegetarians must take extra care to avoid deficiencies of iron, zinc, and B12, which can hurt exercise and strength training performance.

The following tips will help vegetarians who want to get the most from strength training programs.

**How to Get Adequate Protein in Your Diet**

The current protein recommendations for optimal muscle building in a strength athlete is 1.6 to 1.7 gram protein per kilogram of body weight (0.73 grams per pound). For a 200-pound athlete, that is a total of 145 to 154 grams of protein a day. There is no scientific evidence that more than 2.0 grams of protein per kg of body weight has any additional benefit in muscle strength or size.

You can get enough protein by including plenty of low-fat dairy products and protein-rich plant sources, like soy, in your diet. The following protein sources may work for vegetarians:

* Milk, 8 oz, 8 grams
* Tofu, 3 oz, 15 grams
* Yogurt, 8 oz, 8 grams
* Cheese, 3 oz, 21 grams
* Peanut butter, 2 tbsp, 8 grams

**How to Get Adequate Iron in Your Diet**

Heme iron is a type of easily absorbed iron that is found in animal protein. If you eat fish or chicken, you will get this type of iron, but if you eat no meat, you will need to find other sources of iron. Our bodies don't absorb non-heme iron –- the kind found in vegetables -– as easily as the iron that comes from animal foods. Non-meat eaters, especially female athletes, must pay attention to their dietary iron needs. Good sources of non-heme include wholegrain cereals, leafy green vegetables, figs, lentils and kidney beans, and some dried fruits.

**How to Get Adequate Vitamin C in Your Diet**

Vitamin C in fruits, vegetables, and other foods help vegetarians absorb non-heme iron from other foods, so it’s a good idea to eat a combination of foods at each meal. Consider eating citrus fruits with an iron-fortified wholegrain cereal or have a citrus fruit juice with beans.

**How to Get Adequate B12**

Because vitamin B12 is available only from animal products, it is one of the most common nutrients missing from the diets of vegetarian athletes. To get enough B12 (you require only a small amount-2.4 micrograms-per day) try to eat B12-fortified foods like soymilk, and cereal. You can also get enough B12 if you consume eggs, cheese, milk or yogurt.

**Avoid Foods That Interfere with Iron Absorption**

Some foods contain substances that block the absorption of iron in the intestine. Coffee, whole grains, bran, legumes, and spinach all interfere with iron absorption and should be combined with vitamin C to increase iron absorption.

**Talk To Your Doctor About Supplements**

Although dietary supplements should not be used to make up for a poor diet, there are times when they can help prevent some deficiencies. Ideally, you should discuss the use of any supplements with your healthcare team.

All athletes are encouraged to eat a balanced diet that includes a wide variety of foods, but vegetarian athletes can rest assured that they don’t have to eat meat in order to get adequate nutrition for strength building. If you have concerns about your nutritional status, is is recommended that you talk with your doctor or a registered sports nutritionist to review you eating plan and make recommendations.

**Protein Needs for Athletes**

Athletes need protein primarily to repair and rebuild muscle that is broken down during exercise and to help optimizes carbohydrate storage in the form of glycogen. Protein isn’t an ideal source of fuel for exercise, but can be used when the diet lacks adequate carbohydrate. This is detrimental, though, because if used for fuel, there isn’t enough available to repair and rebuild body tissues, including muscle.

**Recommended Daly Protein Intake**

* The average adult needs 0.8 grams per kilogram (2.2lbs) of body weight per day.
* Strength training athletes need about 1.4 to 1.8 grams per kilogram (2.2lbs) of body weight per day
* Endurance athletes need about 1.2 to 1.4 grams per kilogram (2.2lbs) of body weight per day

**How Much Protein is That?**
Not much, as it turns out. Here is a list of some high protein foods.

**Food, Amount, Protein**

Fish, 3 oz, 21 grams
Chicken, 3 oz, 21 grams
Turkey, 3 oz, 21 grams
Meat, 3 oz, 21 grams
Milk, 8 oz, 8 grams
Tofu, 3 oz, 15 grams
Yogurt, 8 oz, 8 grams
Cheese, 3 oz, 21 grams
Peanut butter, 2 tbsp, 8 grams
Eggs, 2 large, 13 grams

Strength athletes believe more protein is important to build muscle. It turns out that strength athletes actually require high carbohydrate intake and adequate glycogen stores to fuel their workouts. It is the strength training workout that leads to increased muscle mass and strength. This is because all high intensity, powerful muscle contractions (such as weight lifting) are fueled with carbohydrate. Neither fat nor protein can be oxidized rapidly enough to meet the demands of high-intensity exercise. Adequate dietary carbohydrate must be consumed daily to restore glycogen levels.

Each category of food is important for health and we should all consume foods from each category. The ratios in which we need to consume these foods, however, is often the topic of a debate.

**Sports Nutrition - Carbohydrate - Carbs**

Carbohydrate is arguably the most important source of energy for athletes. No matter what sport you play, carbs provide the energy that fuels muscle contractions. Once eaten, carbohydrates breakdown into smaller sugars (glucose, fructose and galactose) that get absorbed and used as energy. Any glucose not needed right away gets stored in the muscles and the liver in the form of glycogen. Once these glycogen stores are filled up, any extra gets stored as fat.

Glycogen is the source of energy most often used for exercise. It is needed for any short, intense bouts of exercise from sprinting to weight lifting because it is immediately accessible. Glycogen also supplies energy during the first few minutes of any sport. During long, slow duration exercise, fat can help fuel activity, but glycogen is still needed to help breakdown the fat into something the muscles can use.

Adequate carbohydrate intake also helps prevent protein from being used as energy. If the body doesn’t have enough carbohydrate, protein is broken down to make glucose for energy. Because the primary role of protein is as the building blocks for muscles, bone, skin, hair, and other tissues, relying on protein for energy (by failing to take in adequate carbohydrate) can limit your ability to build and maintain tissues. Additionally, this stresses the kidneys because they have to work harder to eliminate the byproducts of this protein breakdown.

Carbohydrate has other specific functions in the body including fueling the central nervous system (CNS) and brain.

**Storing Carbohydrate**
One gram of carbohydrate provides four calories of energy. Athletes often talk about carbohydrate loading and carbohydrate depletion which refers to the amount of carbohydrate energy we can store in our muscles. This is generally around 2,000 carbohydrate calories, but we can change this number through depletion and loading. During depletion (from diet, exercise or a combination) we use up the stored carbohydrate.

If we don’t replenish these stores, we can run out of fuel for immediate exercise. Athletes often refer to this as "bonking" or "hitting the wall." In the same way, eating large amounts of carbohydrates can increase these stores. This is often referred to as carbohydrate loading or carbo-loading. Our maximal carbohydrate storage is approximately 15 grams per kilogram of body weight [15 grams per 2.2 pounds]. So a 175-pound athlete could store up to 1200 grams of carbohydrate [4,800 calories]; enough energy to fuel high intensity exercise for quite some time.

**How Carbohydrate Fuels Exercise**
Carbohydrate stored as glycogen is an easily accessible source of energy for exercise. How long this energy supply lasts depends on the length and intensity of exercise and can range anywhere from 30 to 90 minutes or more. To avoid running out of energy during exercise, start with full glycogen stores, replenish them during exercise and refill them after exercise to be ready for the next workout.

**Types of Carbohydrate**
Carbohydrates are also divided into simple and complex forms. Simple sugars (carbs) are absorbed and converted to energy very quickly and provide a rapid source of energy. Fruit and energy drinks are a good source of simple carbohydrates.

Complex carbohydrates take a bit longer to be digested and absorbed into the body. They also take longer to breakdown and therefore provide energy at a slower rate than simple sugars. Examples of complex carbohydrates are breads, rice and pasta. Starch and fiber are also considered complex carbohydrates but fiber can not be digested or used for energy. Starch is probably the most important energy source in an athlete’s diet because it is broken down and stored as glycogen. Foods high in starch include whole grain breads, cereals, pasta, and grains.

Other studies link sleep deprivation with decreased [aerobic endurance](http://sportsmedicine.about.com/od/anatomyandphysiology/a/Endurance.htm) and increased [ratings of perceived exertion](http://sportsmedicine.about.com/cs/strengthening/a/030904.htm).

**Balance Exercise with Rest and Recovery.**

It is this alternation of adaptation and recovery that takes the athlete to a higher level of fitness. High-level athletes need to realize that the greater the training intensity and effort, the greater the need for planned recovery. Monitoring your workouts with [a training log](http://erclk.about.com/?zi=8/qBw), and paying attention to how your body feels and how motivated you are is extremely helpful in determining your recovery needs and modifying your training program accordingly.

**10 Ways To Recover Quickly After Exercise**
There are as many methods of recovery as there are athletes. The following are some of the most commonly recommended by the experts.

1. [**Rest**](http://sportsmedicine.about.com/od/sampleworkouts/a/RestandRecovery.htm). Time is one of the best ways to recover (or heal) from just about any illness or injury and this also works after a hard workout. Your body has an amazing capacity to take care of itself if you allow it some time. Resting and waiting after a hard workout allows the repair and recovery process to happen at a natural pace. It's not the only thing you can or should do to promote recovery, but sometimes doing nothing is the easiest thing to do.
2. [**Stretch**](http://sportsmedicine.about.com/cs/flexibility/a/aa040703a.htm). If you only do one thing after a tough workout, consider gentle stretching. This is a simple and fast way to help your muscles recover.
3. [**Cool Down**](http://sportsmedicine.about.com/od/kneepainandinjuries/a/022202g.htm). Cooling down simply means slowing down (not stopping completely) after exercise. Continuing to move around at a very low intensity for 5 to 10 minutes after a workout helps remove lactic acid from your muscles and may reduce muscles stiffness. warming up and cooling down are more helpful in cooler temperatures or when you have another exercise session or an event later the same day.
4. [**Eat Properly**](http://sportsmedicine.about.com/cs/nutrition/a/aa081403.htm). After depleting your energy stores with exercise, you need to refuel if you expect your body to recover, repair tissues, get stronger and be ready for the next challenge. This is even more important if you are performing endurance exercise day after day or trying to build muscle. Ideally, you should try to eat within 60 minutes of the end of your workout and make sure you include some high-quality protein and complex carbohydrate.
5. [**Replace Fluids**](http://sportsmedicine.about.com/od/hydrationandfluid/a/ProperHydration.htm). You lose a lot of fluid during exercise and ideally, you should be replacing it during exercise, but filling up after exercise is an easy way to boost your recovery. Water supports every metabolic function and nutrient transfer in the body and having plenty of water will improve every bodily function. Adequate fluid replacement is even more important for endurance athletes who lose large amounts of water during hours of sweating.
6. [**Try Active Recovery**](http://sportsmedicine.about.com/od/tipsandtricks/a/activerecovery.htm). Easy, gentle movement improves circulation which helps promote nutrient and waste product transport throughout the body. In theory, this helps the muscles repair and refuel faster.
7. [**Have a Massage**](http://sportsmedicine.about.com/od/injuryprevention/a/Sports_Massage.htm). Massage feels good and improves circulation while allowing you to fully relax. You can also try self-massage and [Foam Roller Exercises for Easing Tight Muscles](http://sportsmedicine.about.com/od/flexibilityandstretching/ss/FoamRoller.htm) and avoid the heavy sports massage price tag.
8. [**Take an Ice Bath**](http://sportsmedicine.about.com/od/sampleworkouts/a/Ice-Bath.htm). Some athletes swear by ice baths, ice massage or contrast water therapy (alternating hot and cold showers) to recover faster, reduce muscle soreness and prevent injury. The theory behind this method is that by repeatedly constricting and dilating blood vessels helps remove (or flush out) waste products in the tissues. Limited research has found [some benefits of contrast water therapy](http://www.ncbi.nlm.nih.gov/pubmed/17685683) at reducing [delayed onset muscle soreness (DOMS)](http://sportsmedicine.about.com/cs/injuries/a/doms.htm).

**How to use contrast water therapy**: While taking your post-exercise shower, alternate 2 minutes of hot water with 30 seconds of cold water. Repeat four times with a minute of moderate temperatures between each hot-cold spray. If you happen to have a spa with hot and cold tubs available, you can take a plunge in each for the same time.

1. [**Get Lots of Sleep**](http://sportsmedicine.about.com/cs/conditioning/a/aa062800a.htm). While you sleep, amazing things are taking place in your body. Optimal sleep is essential for anyone who exercises regularly. During sleep, your body produces [Growth Hormone (GH)](http://adam.about.com/encyclopedia/Growth-hormone.htm) which is largely responsible for tissue growth and repair.
2. [**Avoid Overtraining**](http://sportsmedicine.about.com/cs/overtraining/a/aa062499a.htm). One simple way to recovery faster is by designing a smart workout routine in the first place. Excessive exercise, heavy training at every session or a lack of rest days will limit your fitness gains from exercise and undermine your recovery efforts.

**Listen to Your Body for a Faster Recovery**
The most important thing you can do to recovery quickly is to listen to your body. If you are feeling tired, sore or notice decreased performance you may need more recovery time or a break from training altogether. If you are feeling strong the day after a hard workout, you don't have to force yourself to go slow. If you pay attention, in most cases, your body will let you know what it needs, when it needs it. The problem for many of us is that we don't listen to those warnings or we dismiss them with our own self talk ("I can't be tired, I didn't run my best yesterday" or "No one else needs two rest days after that workout; they'll think I'm a wimp if I go slow today.").