June 2004 Volume 1.6

StrengthPro

Sport & Fitness

Strength and Conditioning for Peak Performance

Interval Training

Heat Illness

Putting Your Strength Training Program in Order

Table of Contents

Features

Columns

Sport & Fitness Vol 1.6• June 2004

Personal Training is published four times per year by StrengthPro Inc.

Sport & Fitness is an electronic Journal. Article Submissions are welcome and should be directed to the publisher at news@strengthpro.com

Correspondence, change of e-mail, advertising or subscription enquiries should be directed to news@strengthpro.com

Sport & Fitness is a peer reviewed journal for strength and conditioning professionals, personal trainers, fitness instructors and serious athletes. The journals mission is to publish articles that link scientifc information with practical applications; including research reviews, application articles, and original research.

Sport & Fitnesswelcomes submission of artices and research that would be of interest to our readers. All articles submitted will be blind reviewed by at least two members of the editorial board. submit articles to news@strengthpro.com

Staying and Playing Safe in the Heat

Rebecca Lopez ATC, HFI

Summer is fast approaching, and temperatures will soon begin to rise to dangerous levels. The summer heat and humidity, however, should not deter you from exercising and enjoying the outdoors. Although exercising in the heat could lead to heat illness, becoming aware of the various heat illnesses and of the precautions you can take to prevent them is essential. An understanding of how your body regulates and dissipates heat will also assist in the prevention of heat illnesses.

Thermoregulation

The human body has an internal thermostat in the brain, the hypothalamus, that helps to maintain normal body temperature 98.6 oF (37 oC). The hypothalamus allows the body to adapt to various external environmental changes and internal metabolic functions in order to maintain homeostasis-a state of equilibrium within the body.[1] If the body is unable to maintain homeostasis and heat in the body is not dissipated adequately, this can result in high body temperature, or hyperthermia.

In order to prevent hyperthermia, the hypothalamus senses skin temperature as well as core body temperatures and then sends this information to the appropriate organs in order to ensure thermoregulation.[2] When exercising in the heat, the hypothalamus recognizes the increase in temperature and increases the amount of sweat produced by the sweat glands. Evaporation of sweat from the skin is one way that your body stays cool while exercising. The brain also increases the amount of blood flowing to the skin in order to cool the body, while diverting blood away from the inner organs.

Fluid Balance and Dehydration

Maintaining proper fluid balance is also important in preventing heat illness. The same balance that must occur between heat gain and heat loss in maintaining thermoregulation is needed for maintaining fluid balance and preventing dehydration. The amount of water consumed must equal the amount of fluid lost (via sweat and urine). When exercising, a person can lose an average of 0.8 to 1.4 liters of sweat per hour.[2] If the sweat lost during exercise is not adequately replaced, dehydration can occur.

Dehydration is defined as a body mass loss of at least 3%. Dehydration progressively decreases sweating, stroke volume, plasma volume, and peripheral blood flow; if sufficient rehydration does not occur, these effects of dehydra-

tion eventually lead to heat illness. Exercising while dehydrated is not only dangerous but has also been shown to decrease athletic performance in both anaerobic and aerobic activities.
Exertional Heat Illnesses

There are various heat illnesses that differ in signs and symptoms, treatment, and severity. Being knowledgeable of the causes and differences among these conditions is essential in the proper treatment and prevention of a dangerous situation.

Staying hydrated is essential in hot weather

Heat Cramps

Heat cramps are involuntary, forceful, and usually painful contractions of a muscle. They most commonly occur at the gastrocnemius (calf) muscle and abdomen, but can really occur to any muscle. The exact cause of heat cramps has been unknown; however, many have speculated these probable causes: fluid and electrolyte losses, intense exercise in the heat, improper nutrition, lack of acclimatization, and lack of conditioning.

Treatment:
Treatment of heat cramps involves light stretching of the muscle along with gentle massaging with ice, if available. Rehydrating with either water or an electrolyte drink is a must in preventing the recurrence of the cramp and a worsening of the situation.
Prevention: Drinking adequate amounts of fluid before, during, and after exercise will help prevent any type of heat illness. An evaluation of the athlete's diet will also help determine if he/she is consuming enough electrolytes, such as potassium and sodium, in the daily diet. A loss of electrolytes seems to be one of the most probable causes of heat cramps, and some individuals seem to be predisposed to them. Although the "old school" remedies of drinking pickle juice or taking salt tablets are not recommended, ensuring that adequate amounts sodium and potassium are in the diet (according to the RDA guidelines) may help prevent the recurrence of heat cramps.

Heat Exhaustion

Heat exhaustion is the most common heat illness and is defined as the inability to continue exercising in the heat.[2] Heat exhaustion occurs when exercising in the heat becomes too much of a stress on the body. At this point, the ability of the body to maintain homeostasis begins to fail and the amount of heat gained exceeds the amount of heat being removed. Signs and symptoms of heat exhaustion include cool and clammy skin; profuse sweating, fatigue, dizziness, nausea, headache, and lightheadedness.3 Heat exhaustion can be caused by exercising in

the heat without properly replacing fluids and electrolytes. With heat exhaustion, core body temperature may remain normal or rise a bit but does not exceed 39 oC (102 oF).[2]

Treatment: Treatment of heat exhaustion includes moving the athlete to a shaded or cool area as well as replacing lost fluid and electrolytes. Remove equipment and clothing, such as a helmet, shoulder pads, or any excess clothing in order to better cool the body. Ice packs or towels can be used to cool the body as well. Heat exhaustion usually resolves with cooling and the replacement of fluid and electrolyte losses. The athlete should be monitored and if the condition worsens or does not improve with cooling and hydration, call EMS.

Exertional Heat Stroke

Exertional heat stroke is the most serious of the heat illnesses and is considered a medical emergency. Heat stroke usually occurs as a result of prolonged, strenuous exercise in unacclimatized individuals. It also occurs in athletes wearing protective clothing while exercising in the heat, such as an American football player. The lack of skin surface area does not allow adequate cooling via evaporation of the sweat from the skin. The result is the inability of the body to regulate the elevated temperature, which can eventually lead to death.

Some of the signs and symptoms of exertional heat stroke include high core body temperature (> 40^{o}C [104^{o}F]), dizziness, drowsiness, confusion, disorientation, seizures, vomiting, loss of consciousness, coma, and hot and wet or dry skin.[3] The main differences between heat exhaustion and heat stroke are that with heat stroke there will be an elevated core body temperature (hyperthermia) and an altered mental status (confusion, irritability, delirium, etc).

Treatment: Treatment of exertional heat stroke involves activation of EMS and rapid cooling of the body. Remove clothing and cool the body as fast as possible. The most accepted form of cooling to reduce hyperthermia is ice- or cold-water immersion. This method has been shown to rapidly reduce elevated core body temperature and increase the chances of surviving exertional heat stroke. Core body temperature should be monitored every five minutes to prevent over cooling. Vital signs, such as breathing and pulse should be continuously monitored as well. If ice-water immersion is not available, place ice packs or ice towels to areas of the body near the major blood vessels, such as the neck, groin, and axilla (armpit).

Prevention of Heat Illness

Although knowing the proper treatment of heat illness is extremely important, knowing how to prevent heat illness is the key to exercising safely and worry-free. Proper hydration, being aware of environmental factors, wearing proper clothing when exercising, and acclimatization are all factors that can prevent heat illness.

Hydration

Proper hydration before, during, and after exercise will ensure that balance between fluid consumed and fluid lost. Exactly how much water or fluid is needed really depends on the individual. Some people sweat profusely even when taking a light jog, while others can have minimal sweat losses. Other factors, such as duration and intensity of exercise, as well as outside temperature and humidity play a role in how much water needs to be replaced.

Individuals exercising in the heat should ensure that they are well hydrated prior to exercising. The National Athletic Trainers' Association Fluid Replacement Position Statement recommends 17 to 20 fl oz of water or a sports drink 2 to 3 hours before exercise followed

by 7 to 10 fl oz of water or a sports drink 10 to 20 minutes before exercise.4 Replacement of fluid during exercise should be equal to or close to the amount of fluid lost. On average, this should mean about 7 to 10 fl oz of water or sports drink every 10 to 20 minutes during exercise. After exercise, fluids should be consumed to replenish total fluid loss. According to the NATA position statement, rehydration should contain water, carbohydrates and electrolytes.[4]

The actual amount of fluid consumed before, during, and after exercise really depends on the individual. One of the easiest methods of determining how much fluid is needed is through body mass. Individuals exercising in the heat should be aware of their normal body mass. A pre- and post-exercise body mass is a good estimate of how much fluid was lost with exercise and how much fluid replacement is needed. A body mass loss of about 2 - 3% is already reaching dehydration status. Also remember that thirst is not a good indication of when fluids should be consumed. An individual is already 1% dehydrated by the time they realize they are thirsty.[1]

Acclimatization

Heat acclimatization is exposing oneself to exercise-heat stress gradually, on consecutive days to adapt to the environment and prevent heat illness.[2]

Acclimatization can be achieved by exercising in the heat for a short duration and light intensity and then gradually increasing the amount of time and the intensity level. Exercising with a partner during acclimatization is recommended. Heat acclimatization is generally achieved in about 10 to 14 days.

Weather

Being aware of the environmental conditions, such as temperature, humidity, and wind is always beneficial when exercising in the heat. In hot, humid environments, exercise should be performed in the early morning or late afternoon. Climates with higher humidity make it more difficult to stay cool because when humidity is high, the amount of evaporation of sweat from your skin decreases. Try to avoid exercising in the middle of the day when the temperature and humidity are usually at their highest.

Clothing

Wearing lightweight, breathable, and light colored clothing is always best when exercising in the heat. Try to avoid non-porous and dark colored clothing as well as any clothing that will decrease the amount of skin exposed. If your skin is not exposed, your body cannot cool off through the evaporation of sweat. Also avoid sweat suits, plastic suits, or rubberized suits aimed at rapid weight loss through increased sweat. This weight loss is purely water loss and can be extremely dangerous and even fatal.

Play It Safe

Knowing how to prevent and treat heat illness is extremely beneficial for any coach, athlete, or any other active individual. As the days get hotter and more humid (depending on where you live), playing it safe is always the best approach. Don't let the heat keep you from working out or going outdoors. Make sure you are properly hydrated, exercise at safe times of the day, and be aware of the signs and symptoms of heat illness. Work hard and stay cool!

References

1.Anderson MK, Hall SJ, Martin M. Sports Injury Management. 2nd ed. 2000. Lippincott Williams & Wilkins: Baltimore, MD.

2.Armstrong LE. Performing in Extreme Environments. 2000. Human Kinetics: Champaign, IL.

3.Binkley HM, Beckett J, Casa DJ, Kleiner DM, Plummer PE. National Athletic Trainers' Association Position Statement: Exertional Heat Illnesses. *JAT*. 2002;37(3):329-343.

4.Casa DJ, Armstrong LE, Hillman SK, Montain SJ, Reiff RV, Rich BS, et al. National Athletic

Trainers' Association Position Statement: Fluid Replacement for Athletes. *JAT*. 2000;35(2):212-224.

Rebecca Lopez is an N.A.T.A.-Certified Athletic Trainer in Miami-Dade County Public Schools. She is completing her Master's Degree in Advanced Athletic Training/ Sports Medicine at Florida International University. Email: RLopezATC@yahoo.com

Fun Facts

Elephants have a pulse rate of 27 and for a canary it is 1000!

Half your body's red blood cells are replaced every seven days.

Coughing can cause air to move through your windpipe faster than the speed of sound

The width of your armspan stretched out is the length of your whole body.

The longest bout of hiccups lasted 69 years!

You blink your eyes over 10,000,000 a year.

Research Reviews:

the Science of Training

The Effects of Land vs. Aquatic Plyometrics On Power, Torque, Velocity, and Soreness in Women

Robinson, L.E., S.T. Devor, M.A. Merrick, and J. Buckworth.

Journal of Strength and Conditioning Research. 18(1): 84-91, 2004.

Its likely you know all about plyometrics - the exercise that involves lengthening of the muscle while it's contracting and producing force. You probably also know that the technique takes advantage of the elastic energy stored within the muscle fibers during the deceleration phase of the movement by releasing it during the acceleration phase of the movement. This results in a much more forceful contraction than normal. You may even know that plyometric training can result in the development of more power and strength in less time than with traditional strength training. But do you know what problems can occur with plyometric training, especially when performed improperly and in populations that don't have the prerequesite strength levels?
The problem with plyometrics is that the repetitive ballistic movements can be very tough to perform, they often cause excessive muscle soreness and damage, and they can even lead to serious injuries such as meniscal damage, straining of the connective tissue of the patella, inflammation of the Achilles' tendon and heel bruises. Now, do you know a creative way to remedy the problems associated with plyos without disturbing its effectiveness? If you're thinking swimming pool, then you're right on track.

In the lab: Scientists from Ohio State University (Columbus) wanted to see if a plyometric program done in water would lead to the same benefits provided by a plyometric program done on land, yet reduce muscle soreness. So they had 32 female college athletes, who were regular exercisers for at least 6 months, participate in an eight-week, lower body plyometric training program that was performed three times a week. Half of the women performed their plyometric workouts in a gym and the other half exercised in 4-4.5 feet of water (about chest height) in a swimming pool. The workouts were identical except for the environment and consisted of a series of 10 bounding, hopping and jumping drills with boxes that were done for 3-5 sets of 10-20 reps each and lasted 50 minutes (not including warm-up and cool-down). Training volume was increased after two weeks and again after five weeks. To assess performance, the subjects were tested for peak power on the vertical jump test, peak torque with an isokinetic leg extension and flexion machine, and peak velocity in the 40-meter sprint at the beginning, after four weeks, and at the end of training. They also measured muscle soreness using a self-report muscle soreness scale and pain sensitivity using an algometer (a device that measures the pressure applied to a muscle when the researcher presses on the muscle with a rubber disc (the less pressure they can

withstand the higher their pain sensitivity) in the rectus femoris, biceps femoris, and gastrocnemius muscles. Muscle soreness and pain testing was performed immediately after training, 48 hours after, and 96 hours after training on the first workout day of the program and after the volume was increased at the start of the third and sixth week of training.

The results after the eighth week indicated an increase in vertical jump height of about 11 cm (~34%) in both the gym group and the pool group; an increase of peak torque during leg extension of 38 Newton meters (25%) in the gym group, and an increase of 40 Newton meters (25%) in the pool group; an increase of peak torque during leg flexion of 37 Newton meters (45%) in the gym group and an increase of 39 Newton meters (45%) in the pool group; there also was an increase in peak velocity of 6% in the gym group and 7% in the pool group. Muscle soreness and pain sensitivity appeared to be about 150% greater and almost 100% greater, respectively in the gym group at 48 and 96 hours post-training at all three training phases.

The Ohio State research group concluded that an aquatic plyometric program could lead to comparable training gains as a land-based plyometric program with less muscle soreness. They attributed the decreased muscle soreness and pain that the athletes experienced and the increased power, torque, and speed to the fact that water provides a "nonimpact medium" that reduces the strain on muscle, bone, and connective tissue experienced during similar exercises on land. In addition, movement in water provides greater resistance than experienced on land. Therefore, aquatic plyometric training offers the best of both worlds as the reduced stress that the muscles experience is balanced out by the increased resistance to provide an environment that minimizes injury and maximizes performance enhancements.

On the Field: It appears that plyometric programs performed in a pool have some definite advantages over similar programs done in the gym. The fact that all performance measures were so similar between the gym and the pool plyometric groups, yet muscle soreness and pain ratings were significantly lower in the pool group suggests that an aquatic plyometric program will be beneficial at inducing performance enhancements while preventing the severe muscle soreness and even injury that often accompanies plyometric training. If you have access to a pool consider starting athletes - who are new to plyometrics, or are coming back after an injury or the off-season - with an aquatic plyometric program for at least the first 4-8 weeks. This may also be a great way to get clients who are elderly, obese, or those with chronic conditions such as arthritis on a program that can greatly increase their power and strength. Be sure that the water height is about 75% of their standing height (or about chest level) and no lower or higher, and try to make the water temperature as comfortable as possible.

Jim Stoppani, Phd

Science Editor Muscle and Fitness and Flex

Picking Up the Pace: Interval Training

Ed McNeely

Interval training is a popular form of training amongst many athletes. While most endurance athletes will use intervals at some point in the year few really understand the purpose of intervals or how get the most from this valuable training method.

Physiology of Interval Training

Interval training involves alternating periods of high intensity work with periods of lower intensity work, usually, but not always above and below anaerobic threshold. By alternating periods of higher intensity work with lower intensity work several things are accomplished:

The amount of high intensity work is maximized. If you were to try to hold an intensity above anaerobic threshold for as long as possible you would fatigue in just over 20 minutes. If you were to do 6 x 5 minute work intervals with a rest period in between you would have done 30 minutes of work above threshold. Since the volume of work above threshold was higher it should give you a greater training effect. The same holds true for VO_2 max and anaerobic intervals.

During the work period of the interval you will be producing lactic acid, which your body will have to deal with during the rest period. Active slow twitch muscle fibers are capable of using lactic acid as an energy source. Repeatedly exposing your body to moderate levels of lactate and then allowing it to recover gradually trains your body to become more efficient at lactate removal as you r body develops the enzymes necessary to convert lactate back to glycogen or glucose. This will translate into lower lactate and faster times during a race since you will be able to deal with the lactate as it is produced. Of course this training effect will only happen if you have done adequate base training.

The aerobic capacity of fast twitch fibers is improved with interval training. The more often a fiber is activated the greater it's oxidative capacity. Interval training is the only ways to activate the fast twitch fibers frequently enough to improve their aerobic capacity, making them behave more like slow twitch fibers.

Designing an Interval Training Program

Interval training is high intensity and needs to be planned very carefully in order to avoid overtraining. The most important component of an interval program is the base work that is done prior to starting intervals. The initial 6-8 weeks of your training should be devoted almost exclusively to low intensity long duration training, 60 minutes or more per session. This will prime the slow twitch fibers and improve their fitness, so that they can accept the lactate that will be produced when intervals are started, allowing you to make effective use of interval training.

The Work Period

The duration of the work period will vary depending on the intensity of the interval. A work load just above anaerobic threshold will need long intervals, 5-10 minutes, while higher intensity anaerobic intervals can be as short as five seconds. Consistency is the most important factor in interval training. The power output or split time should be the same for each work piece of an interval session. In other words if you are doing 5 minutes at 8 mph on the first interval all other intervals should be done at the same pace. This ensures that you are maintaining the appropriate intensity and recruiting the same muscle fibers in each interval, improving the training effect. It does very little for you to do an interval session where the first interval is 8 mph the next is 9 mph the

next 9.5 mph etc. Be sure to choose an interval duration and pace that allows you to be consistent throughout the workout.

Choosing paces for the work intervals requires a little up front work on your part. You need to have an idea of your pace for both anaerobic threshold and VO_2 max. Anaerobic threshold is approximately the maximum pace you can sustain for 30 minutes while VO_2 max is approximately the maximum speed you can hold for 4 minutes. Training paces will normally be set at anaerobic threshold, VO_2 max or half way between.

The Rest Period

The rest period is as important as the work period. The purpose of the rest period is to allow time to remove the lactate created during the work interval, and allow the anaerobic alactic energy system to replenish itself. During aerobic intervals, intervals longer than two minutes, the rest period is active, meaning you continue to row but at a lower intensity. The duration of the rest period will depend on the duration and intensity of the work period. Aerobic intervals will vary for a 1:1 to a 1:4 work rest ratio. Anaerobic intervals are a completely different story and will be covered in a future article. When choosing the duration of your rest period, follow these simple guidelines: 1). The longer the work the shorter the rest. Longer intervals are normally done at lower intensity, requiring a shorter rest period. A five minute interval just above anaerobic threshold will produce moderate levels of lactate requiring less time to recover so a 1:1 or 1:1.5 work to rest ratio can be used. A higher intensity two minute interval will produce

Table 1: Work and Rest Period for Various Interval Intensities

Type of Interval	Work Period	Work:Rest	Notes
Anaerobic Threshold	3-10 min	1: 1 or 1:1.5	Just above and just below threshold
Supra threshold-Sub Max	2-7 min	1:2 or 1:3	Halfway between AT and VO2 max. Recovery at half speed
VO_2 max	1-4 min	1:3 or 1:4	Work at VO_2 max recovery at half speed
Anaerobic Sprints	5-60 seconds	1:6	All out sprint passive recovery

more lactate and therefore require a longer recovery. 2). Adjust the duration of the rest period

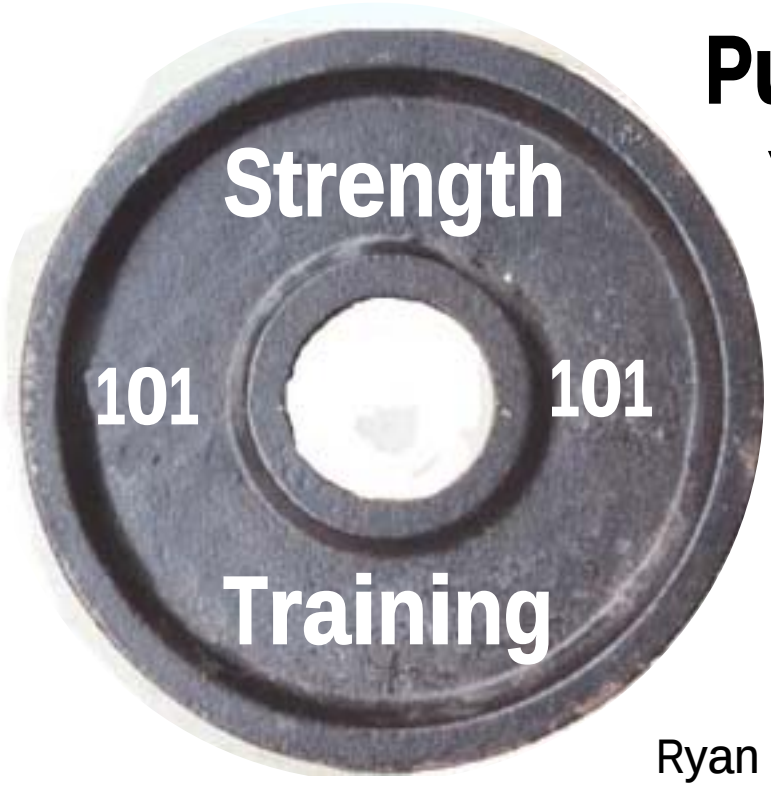
so that you can maintain a consistent split during the work period. It may happen that you decide to do 5 minutes of work followed by 5 minutes of rest, repeated 5 times. Half way through the workout you notice that you can't hold the same work rate. Finish the training session, coming as close as possible to the desired pace. For the next session increase the duration of the rest period by 50%. If you still cannot hold the desired pace for all the work periods drop the pace for the rest period by about 10% for the next workout.

Most endurance athletes will use some combination of all four types of intervals in their training program. For those competing in shorter races, 10 minutes or less the VO_2 max and anaerobic sprints should make up the bulk of your interval training, while those doing longer races, 60 minutes or more, will focus their interval training on anaerobic threshold intervals.

While interval training is a great way to improve speed, it is easy to overdo it and do yourself more harm than good so take it easy when starting by doing only one session per week and increasing by one session per week every two weeks until your are doing at most four sessions per week.

Exercise of the Month: The Tuck Jump

The tuck jump will help build explosive vertical jump power as well as increase strength through the hip flexors. Stand with feet about shoulder width apart. Swing the arms back and quickly dip until the knees bend to about 120 degrees. Explode upward extending the knees, hips, ankles and trunk while swinging the arms forward and upward as explosively as possible. Focus on completely extending the body, reaching as high as possible.While in the air, quickly pull the knees into the chest, grabbing them with both hands prior to landing. Try to keep the trunk as upright as possible throughout the lift, many people will simply bend forward from the waist to get their knees to their chest, this defeats the purpose of the exercise.



Putting Your Strength Training Program in Order

Ryan

Whether you are an experienced lifter or a before-and-after the weekend workout maniac, you have inevitably walked into the gym and thought, "well, what should I do today?" Once you have surveyed the room to see what equipment doesn't have a line up at it so you can choose what body part you will train that day, you must decide what exercises to do and in what order.

Although we may not think that we make a conscious decision as to the order that we perform exercise, by using our previous experience we often end up doing what is most effective without even thinking about it. If you walked into a gym on Monday afternoon with the intent of training chest, 9 times out of 10 you would walk right over to the bench press and start pounding out reps. Why do you do this? Because through your training experience you have learned that if you want to lift big weights in your bench press, the best time to do it is at the start of your workout. And lifting big weight will make you strong. And there you have it, based on what you decided you want to accomplish in your workout, you have subconsciously determined you order of exercises for the day.

But surely there's more to it than that? In essence, not really. The order in which you perform exercises throughout your workout is ultimately determined by your training goals. Once you know what you want to accomplish, you must set up your workout so you can meet your goals as effectively as possible. Although there are dozens of factors that could ultimately affect the order you perform various exercises, lets look at a few common scenarios, and using some of the science behind training, determine what exercise order is best for meeting your goals.

Perhaps the most prevalent goal in the gym is simply to get strong. How do we get strong? By lifting heavier weights and building more muscle. In order to lift the greatest amount of

weight we must produce a large amount of force. Science has found that this is dependent on muscle fiber recruitment. The more fibers that we are able to recruit to perform a movement, the greater the force that we are able to produce. It seems to reason that the largest amounts of muscle fibers would be located in the largest muscle groups. Now that we have determined that to produce a large force we need to use a large muscle, we must decide what exercise best targets that large muscle group. Sticking with our bench press example, if our goal is to produce a large upper body force, the muscle that we will likely target is the pectoralis major. The best exercise for getting the most out of your pec major is the bench press. By using a large compound movement such as this you are able to call upon more muscle fibers, which enables you to lift a heavier weight and ultimately produce more force. By performing this exercise at the start of your workout you are able to ensure that the muscle fibers you are recruiting are fresh, and therefore can be worked to their maximum potential. If you wait to perform an exercise until that muscle group is fatigued, the amount of force that the muscle is able to produce is drastically reduced. The rest of the exercises in your chest workout can now follow in your determined order of priority.

In simple terms then, if your goal is to get as strong as possible, you want to create as much force as possible. To create a large force you must use a large muscle group, and perform an exercise that targets this group. This is the reasoning behind having a "core" exercise for reach muscle group. That is, one exercise that targets the muscle as a whole and required you to recruit a large amount of muscle fiber. The most effective way to do this is to perform this exercise at the start of your workout, when the muscle is at its greatest force production potential.

Let's now look at another common goal of training: power development. Power is defined as the amount of work done over a period of time (w/t), where the goal is to do the greatest amount of work (or produce the largest force), in the shortest amount of time. The two things that must be done then to develop power are to create a large force, and at the same time try to create this force rapidly. As we discussed earlier, the secret to force production is muscle fiber recruitment. The more fibers we recruit, the larger the force. Therefore, as with developing strength, we want to use our largest muscle groups and the exercises that target these muscles. And as with training for strength we want to perform these exercises as early

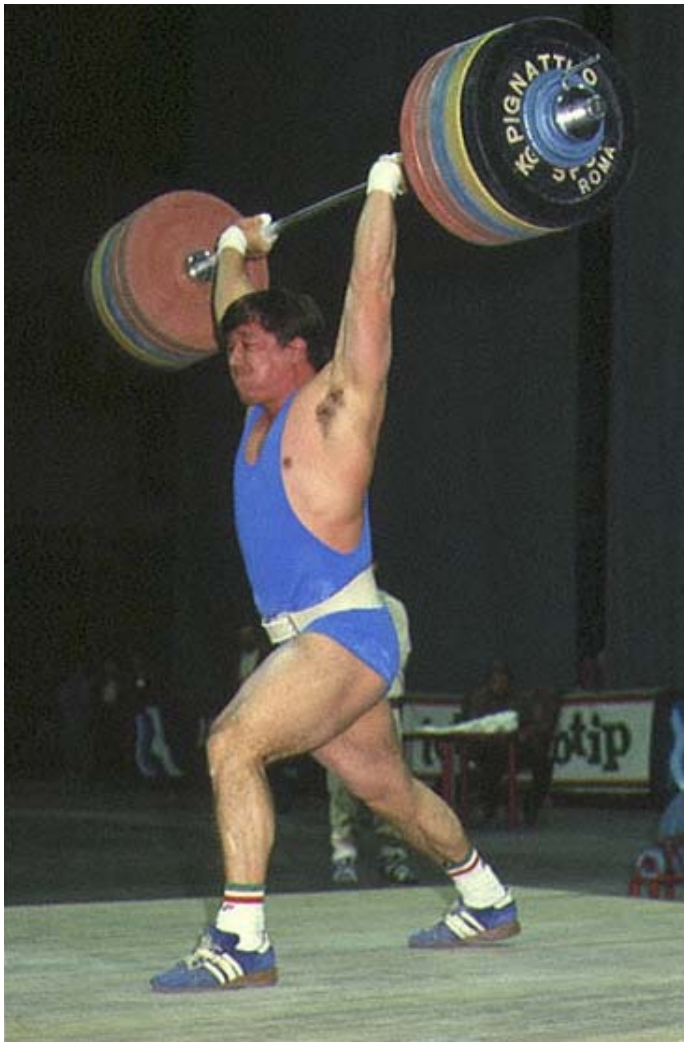
Fitness Facts

Elite Cross country Skiers can have VO_2 max values as high as 100ml/kg/min. The average male has a VO_2 max of les than 30 ml/kg/min.

The world record in the bench press is now over 900 lbs

as possible in the workout, thus avoiding more severe detrimental levels of fatigue.
The second part, and perhaps the key to power training, is the Rate of Force Production (RFP), or simply the speed at which force is produced. What this basically says is that to be powerful we want to generate force against a resistance as quickly as possible. Research has continually shown that the rate of force production capability of a muscle or muscle group declines steadily with continued exercise. When explosive type exercises, such as plyometrics, are performed for a number of repetitions, there is a notable difference in the force production of the first few reps as compared to the last few reps. It has been found that it is both muscular and neurological fatigue that contributes to this decrease in force producing capability. Therefore, while muscles are capable of producing large amounts of force, they are not able to continue producing these same forces for extended periods of time.

So what does this all mean? Simple. If we are training for power, in order to see the maximal benefits we must perform our power training at the start of our workout. At this time both the muscular and neurological systems are at their maximum force, and rate of force production, capabilities. If we wait to perform our explosive exercises until later in the workout, our already fatigued muscles will not be able to produce as large a force, and definitely won't be able to produce it as quickly, as if these muscles had not previously been stressed. Producing low forces over longer periods of time is NOT the goal of power training.



Power moves are done early in a workout

Let's look at how this can be applied to your workout. If a leg training session is the order of the day in the gym, and we are looking to improve our lower body power, what order do we do our exercises in? Let's assume that our exercises of choice are a power clean, a squat, a step-up, and a hamstring curl. Since we know that to maximize results we want to perform our explosive exercises at the start of our training, we would start with power cleans. Since we now know that force production and speed decrease with time and fatigue, performing this exercise later in the workout will drastically reduce its benefit to power training. Now that we have the most explosive part of the workout completed we can then move on to the second most important exercise, likely the squat. As force production is a major component of power, we would want to use our largest lower body muscle group while it is still relatively little

fatigue, in order to improve our lower body force production. Remember from our previous discussion, large muscle groups equal more muscle fibers, and therefore more force production. Following the squat we can perform our step-ups and hamstring curls in whichever order we desire. The order of the exercises after the power cleans is not set in stone, however, and can be changed according to the goals of the workout. For example, if our intent is to perform the step-ups explosively (as fast as possible), then they would be a higher priority in our power workout that the squats. Remember that we want to perform our exercises that require the greatest power (and rate of force production) early in the workout, prior to the increase in level of fatigue. This ensures that we get the most out of our power training.

Now that we have examined a couple of the most popular methods of training, and looked at some of the research behind what makes these methods effective, hopefully you will be able to take something away from this article and apply it to your current training program in order to see the kinds of gains that you are looking for. To summarize, here are a few points to take with you as you head for the gym:

1. Explosive exercises should be performed first, before the muscles are fatigued.

2. The larger the muscle group, the more force it is capable of producing.

3. Major exercises for a muscle group ("core" exercises) should be performed before auxiliary exercises, so that force production is maximized.

4. Ultimately, exercise order is dependent upon the goals of your training session.

StrengthPro would like to thank it's sponsors

GNC PRO PERFORMANCE®

FLEX

Muscle & Fitness

CorMAX Strength-Power Systems

StrengthPro

Speed and Power Certification

The quickness to break through the line and accelerate past tacklers, grabbing a rebound out of the hands of your opponent, ripping off a 130 mph tennis serve or driving a golf ball 300 yards all have one thing in common. They all require incredible power.

Power, the optimal combination of speed and strength is essential for sport performance and is the difference between good and great athletesNot every sport has the same power requirement, being able to determine the ideal relationship between speed and strength for a sport, test an individual athlete for their strength and weaknesses and teach proper exercise progressions will allow you to develop more effective training programs and separate yourself from other trainers in the filed of athlete development.

With this in mind StrengthPro has created a certification that covers every aspect of power and speed development, from the science, to the exercises, to the development programs to maximize you clients results.

This four session lecture-workshop will provide each participant the skills and knowledge needed to develop explosive power programs. Examining both historical perspectives and the newest, scientific approaches for developing power the workshop will consist of approximately 50% of the time being devoted to lecture and 50% to practical application hands on applications, allowing participants to bridge the gap between science and practice.

Session 1: The Strength-Speed-Power Continuum

This lecture session will introduce participants to the physiological basis of power development and the Strength-Speed Power continuum. To develop optimal power one must first know whether that power is strength based or speed based. The continuum allows the participant to analyze the power demands of a sport or activity and determine the proportions of strength and speed needed to excel. Other topics covered include:

- Muscle and Nervous system physiology

- Force-velocity curve
- The length-tension curve
- Acceleration, Torque and Impulse
- Elastic energy, the stretch reflex and momentum
- Dynamic Power Expression
- The trade – off between strength and speed
- Where does optimal sport specific power lie?
- Sport and position specific power analysis

Session 2: Developing a Power Profile

During this practical workshop participants will be lead through a series of specific and general strength, speed, and power tests. They will learn to administer the test protocols, interpret the results and set training priorities and goals based on the testing and how the results match the strength-speed-power continuum analysis.

Session 3: The 5 Step Power Program

This lecture session provides the program variables and theoretical framework for designing specific power programs. The 5 step model provides participants with a simple, effective means of ensuring that they are covering ever aspect of power development. Topics covered include:

-

Training muscles vs. training movements
- Replication and skill transfer
- The weight training paradox
- Power periodization cycling
- Antagonistic power combinations
- Volume-intensity relationships
- Overload
- Acceleration and deceleration

Session 4: Power Techniques

Building on the previous session, this hands on session features the drills, exercises and training methods discussed in the previous lecture. The group will be broken into smaller groups and cycle through four different stations where participants will learn and learn to teach ten different exercises and drills for a total of 40 new exercises ranging from releases and throws to plyometrics and Olympic lifts.

For information on a certification course in your area call 1-800-255-1017
www.strengthpro.com

Sports Performance Symposium





StrengthPro has teamed with GNC Show of Strength to bring you a series of informative, practical and scientific lectures on developing speed, power and strength. This full day symposium will deliver eight energy-packed hours of cutting edge training information. Featuring some of the industry's top speakers this is a must see event.

Preliminary topics include:

- Determining the Power Profile of Your Sport
- Assessing Speed, Strength and Power
- Building a Sound Training Base
- Maximizing Strength
- Developing Explosive Acceleration and Speed
- Creating Maximum Power
- Transferring Training to Performance
- Nutrition and Supplementation for Sports Success

For more information visit www.strengthpro.com